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The Providence Steam-Engine Fly Wheel.

BY JOHN RANDOL.

Fly-wheel construction is a very interesting subject. A large mass of metal moving at a high speed is always a matter of some solicitude to the engineer, no matter whether he stands at the drawing board, at the foreman's desk in the shop, at the engine throttle, or in the counting room, the large, swift fly wheel is a matter of deep interest everywhere. The designer wishes to lay down a good, cheap and eye-pleasing structure, because the quick fly wheel must be good in construction to stay together in service, and if not easily put together the effort to make it secure brings the cost far above what it should be, and the fly wheel is so visibly important that an ugly, ill-designed fly wheel ruins the whole general appearance of an otherwise finely proportioned steam engine. The foreman is solicitous because he knows the fly wheel must be perfect in construction, and because the pieces of a large fly wheel are always fully up to the capacity of his tools, and quite commonly so far beyond the size his tools were made to take, that he must resort to numerous expedients, all involving careful consideration, to machine the parts of the big job in any manner. The engine man, the "Engineer" as we say in America, has a careful eye to the wheel, and many a man never turns on the steam without thinking of the fly wheel, which he believes is not so strong or so well fitted in some of its parts as it should be, and so liable at any moment to become the cause of a disastrous wreck. Fly wheels often fail, and very often with fatal results. The office is interested in the cost and appearance of the wheel in the first instance, but is more solicitous for its stability and permanence; fly-wheel accidents are often enormously expensive to the constructors, as well as to users, and prudent business management on the part of both builders and operators of fly wheels demands that no needful care or expense should be spared in fly-wheel construction; yet the engine purchaser looks hard at the price, and the engine builder seeks to meet the purchaser's views, and the heavy, costly fly wheel often takes its chance in the general cheapening which follows a contract at close figures. All this brings the fly wheel back to the drawing room where the designer stands before the trestle board and constructs the wheel in his mind, weighing anxiously the advantages and disadvantages of each variation of construction which passes before his inner vision, and many a time in the end sacrificing his own preferences to considerations of cost and the tools through which his wheel parts must pass in course of construction. The fly wheels put out by the Providence Steam Engine Company, and the working drawings and shop views of their construction here given will be of interest to all steam-engine designers and constructors, and those who see them will undoubtedly appreciate the liberality of the management of that old and well-known engine-building establishment in furnishing drawings of its latest practice for this public use.

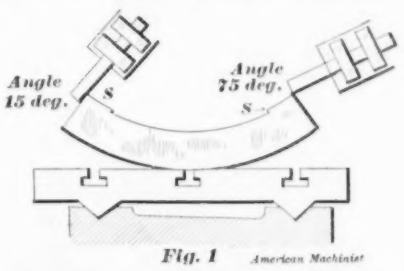


Fig. 1 American Machinist

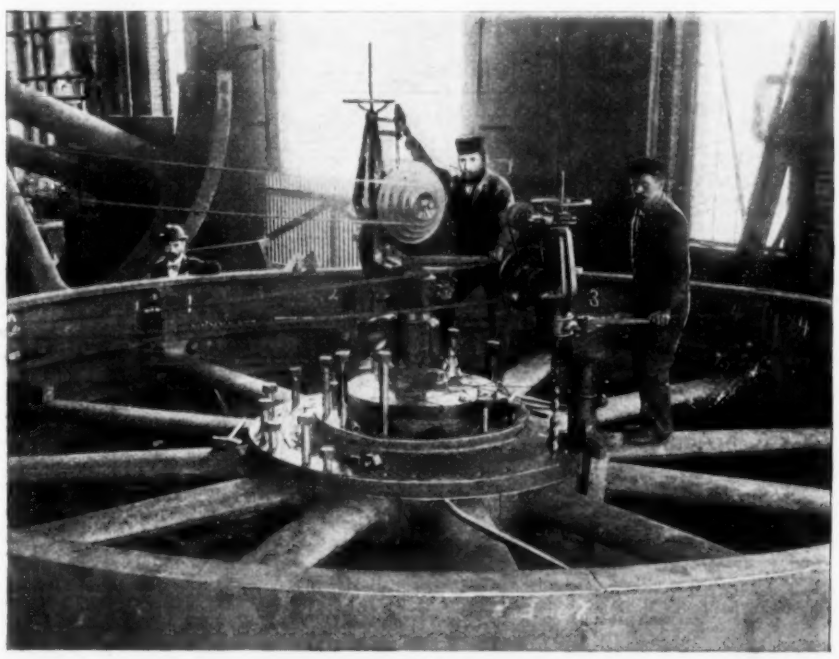


Fig. 3.

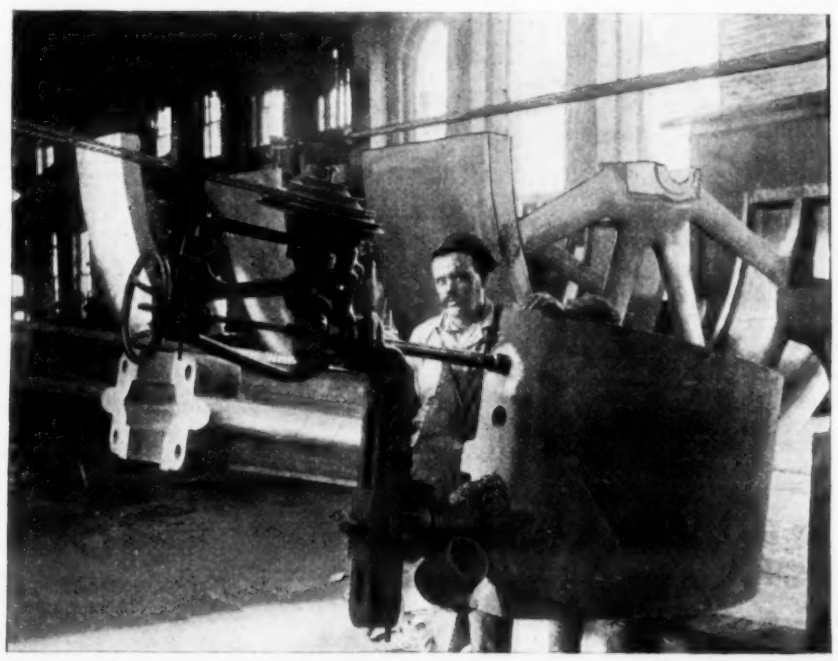


Fig. 4.

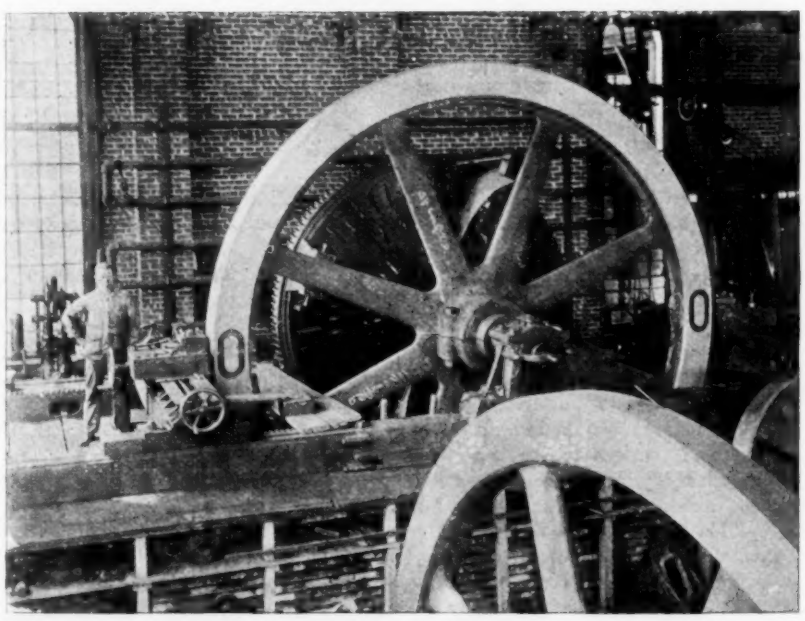


Fig. 5.

PROVIDENCE STEAM ENGINE CO.'S FLY WHEEL

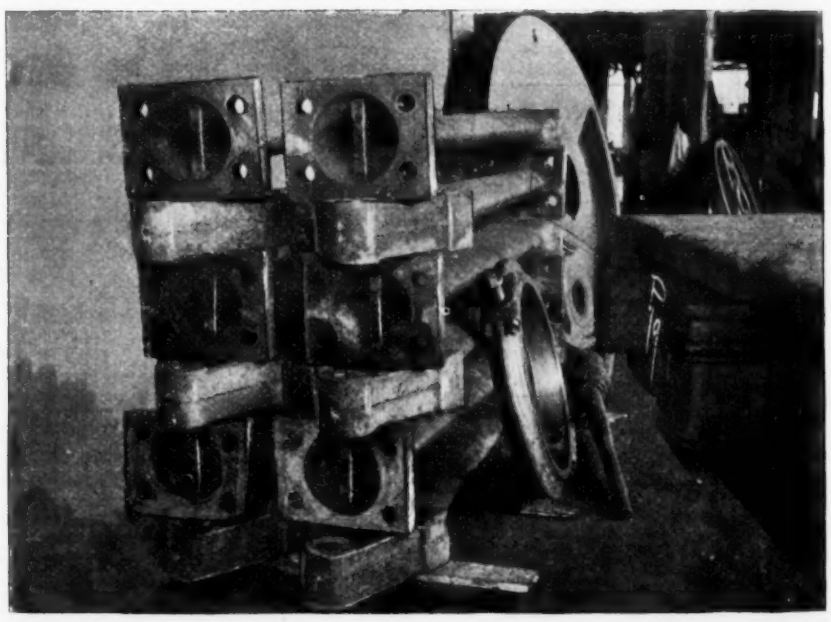


Fig. 6.

The rim of a segment built fly wheel may

have the arms attached either in the middle of each segment, or at the joining of adjacent segments; this latter method is preferred by the Providence Steam Engine Company. Where the arm is fastened in the middle of the rim segment the planing of the segments is somewhat easier, but probably the mode here shown is the stronger of the two. Fig. 1 shows the planer tool-slide angles for a 12 segment rim; the meeting ends are, of course, faced with the tool slide set at 15 degrees; the seats for the T-end arms are planed with the tool slide set at 75 degrees, as 75 + 15 = 90, and the surface of the arm seat must be at 90 degrees, or at a right angle to the joining face. The length of the segment must be carefully measured from corner to corner, on the top as shown in Fig. 2, to make the diameter of the rim come right.

On the drawings this length is given as 68.33 inches on the long side of the segment, which is the under side in Fig. 1, and it appears to be an error to give the figures for the long side, as the planer hand has to measure from rough corners to a hundredth jobs of lathe work, and require no special mention.

Fig. 3 shows the wheel rim and arms bolted up, and the hub drilling in process with the usual portable drills.

Fig 4 shows the process of drilling one side of a smaller fly wheel made in halves, and such a fly wheel is shown in Fig. 5 in the big lathe in process of turning. This lathe pit is of brickwork, put in when the new part of the shop was built; the lathe swings 30 feet and cost about $4,500. As a curiosity of photographing it may be mentioned that the lathe hand at the right stood perfectly still for the slow plate five-minute exposure; his features are sharply defined in the negative, showing that the position was not changed in the least during the whole five minutes. Standing still is, of course, not his only strong point.

The two halves of the fly wheels shown in Fig. 4 are planed by being set alongside the planer with the joining face vertical, and using a tool carried on a vertical slide on a knee bolted to the planer table, the work, of course, standing still.

excellent specimens of marine engines, pumping engines, and machinery generally.

The most reliable workmen in the finishing shops, where my apprenticeship of five years was served, were millwrights, who were equally skillful in shaping either wood or metals, and I was so fortunate as to be detailed by my foreman as a helper to one of the best of them, who, in the absence of the foreman, acted in his place. He had a good supply of resources, and could get over a knotty matter, or turn a sharp corner quite readily. I recall one case, that of the wrought-iron carriages designed by Capt. John Ericsson for the wrought-iron guns placed on the U. S. Steamer 'Princeton." None of the work on them, except drilling the holes for the rivets, was done in a machine. The bearings for trunnions, for axles, and for the gear for running in and out, for elevating, etc., were bored by a temporary bar, rotated by the helper. As these necessarily had to be parallel, great nicety in the adjustment of the fixtures was required and obtained. The modern planer, slotter, shaper, horizontal borer, *et id omne genus*,

ters of intersecting streets. But it was accomplished by passing heavy timbers under the boilers, and then under the projecting ends of these transverse timbers whose ends were secured beneath the axles of ordinary carts, and hauling them by horses. After some mishaps by the breaking down of the carts when inequalities of the paving caused one or the other to have more than its share of the weight, the boilers were finally hoisted into place. The transportation of the engines was comparatively easy.

Before the erection of the machinery was completed freezing weather was feared, and the ship was ordered to be taken to New Castle and moored between the ice piers in the Delaware, opposite that town, and she was kept there until completed in the following spring. That winter is marked by a black letter in my calendar. No fires were permitted on board the ship, although the weather was extremely cold.

In the gang engaged in erecting the engines and boilers were four apprentices, patternmaker, boilermakers and a machinist. The latter had under his charge a foot lathe,

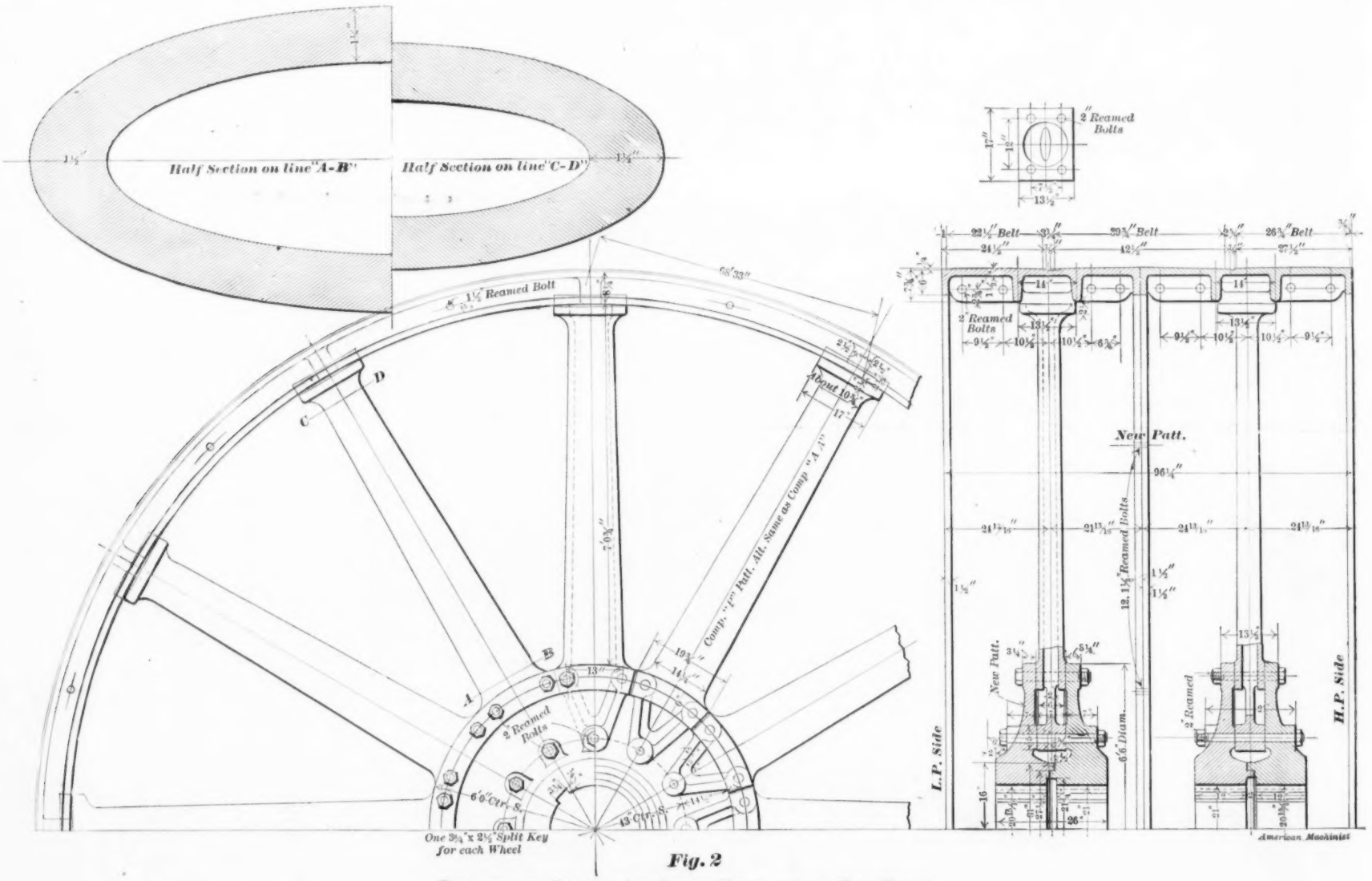


Fig. 2

DRAWING OF PROVIDENCE STEAM ENGINE CO.'S FLY WHEEL.

of an inch; if the measurement had been given from the inside the measurement would have come in the easy place to be made by the planer hand, and would also be from one sharp finished corner to another of the same kind; probably the measurement would not have been put where it is on the drawings if the draftsman had been also a planer hand.

The arms of this wheel are oval, with one T-end and one flat end, and are ingeniously cored through, the core being forked out into open sand on each side of the hub end of the arm just before the arm eye for the inner arm bolt is reached, and a bridge being left across the opening of the T-end to take the lathe center; the other end is solid. The arms are first centered and the T-end is then faced in the lathe; the arms are then placed on the planer centers and the flats of the hub end are finished; this brings the arm all true with itself. The arm bolt holes at the T-end are probably drilled with the "Dallet" portable, which is so much used in these shops. This is not certain, however, as this step was overlooked.

The two halves of the wheel hub are plain

The student of machine detail cannot withhold his admiration of this elegant example of fly-wheel design shown in the working drawings. It is a fine piece of work from all points of view; easy founding, easy finishing, easy assembling, and beautiful when in place – a credit to its originator, whoever he may have been.

Some Recollections of Machine Shops in the Early Forties.

BY WASHINGTON JONES.

It will be remembered by those members of the American Society of Mechanical Engineers who were present at the Detroit meeting, that Mr. Allison's paper, entitled "The Old and the New," elicited a short discussion upon the early methods of machine construction. As the great majority of the members of the American Society of Mechanical Engineers are still in the prime of life, and well up in modern practice, it may not be uninteresting to them to be told how the ancients contrived with inadequate machine tools, to produce such

have done away with the necessity for such workmen, and they have made their exit. "Peace to their ashes."

In the discussion some allusion was made to the bed plates of the engines of the U. S. Steamer "Mississippi," which probably were the heaviest castings of their kind made in the United States up to their time, and a continuance of the history of the construction of her machinery may be in order. The engines were of the well-known type used in the English Navy. Side levers connected at one end by side rods to the crosshead of steam cylinder, and at the other end by short extensions from the cross tail, and from it by the main connecting rod to the crank pin. The piston rods were guided by the Watt parallel motion. The three boilers, of the double-return ascending flue type, were of copper, and weighed each about thirty-five tons.

As the shops where they were built were between the fourth and fifth streets from the Philadelphia Navy Yard on the river front, where the ship was built, and was then lying, it was a difficult matter to transport them over cobble stone paving and the deep gut-

and his duties were to chase threads on the shanks of all the oil cups, to turn and thread small bolts and such other little matters of turned work as were required. Those who have not tried it can scarcely imagine the difficulty of starting a screw thread upon a blank, whilst kicking the treadle of a foot lathe, especially when the operator is a cub of two years growth, as the swaying of the body interferes with the steadiness of the hand holding the chase. Often the threads were so "drunk" as to require the services of a "doctor."

I learned that it could be done, and was not such an impossibility as that named in the Scotch proverb, "You can't whistle and lick meal."

While on the ship I was detailed to grind in the plugs of the blow-out cocks whose shells had been badly bored, or rather reamed out, with a cutter inserted in a block of wood turned to the required taper, fed down by a screw and turned by levers. This expedient proved to be a failure, as the cutter when opposite the openings in shell, having less material to cut away, sunk down and then rose when cutter encountered the

continuous surfaces of metal. The cocks were in place near the bottom of the boilers, and the job was a long and disagreeable one. With two feet of bilge water below, and the overhanging part of the boiler above, a stooping position had to be assumed; but with an expenditure of oil, fine emery, time and much patience they were made tight. The making of cocks and valves was not a specialty in those days, but when wanted the lathe work was done by the first man out of a job and, as might be expected, they required a lot of grinding-in by hand.

The grinding material for small cocks and valves was obtained by stirring a handful of foundry loam into a glass vessel filled with water, and when the heavier particles had sunk, to pour off the supernatent portion into another vessel and letting it stand until the fine sediment was deposited, which was then used with water.

As the engines of the "Mississippi" approached completion, and when the moving parts had been connected, the usual course of turning them over by hand was taken. The readiest way to do this was to pass a hawser around a paddle wheel and attach it to the windlass. (This, by the way, was of English make, and had the British coat of arms cast upon it. This was considered out of place on a warship of the United States, and the order was given to chip it off. Now, the contracts for warships of the United States require all material to be of domestic production. The one is of "the old," the other is of "the new.") The paddle wheel went around until the crank was nearly upon the upper center, when it came to a stop. Then an investigation was made to learn the cause, and it was concluded that the steam piston "bottomed," or some foreign substance was in the cylinder, a bolt or nut, chisel, hammer or what not. To test this a bonnet was taken off the lower steam chest, the double-beat puppet valves lifted out, and the smallest "cub" was invited to enter through the valve seat and steam opening into the cylinder, which he succeeded in doing by contorting his limbs into several unnatural positions. When inside the cylinder a block of wood (by special request) was passed in, and a hand lamp. Then a discovery! The "cub" passed out to his foreman three or four pebbles of about ¼ inch diameter. Immediately there was a hullabaloo. "Somebody is trying to break the piston, or to break down the engine."

How those pebbles got into the cylinder was a mystery. Each of them, when found, could have been mashed by a blow from a tack hammer, and the accusation made against the imaginary "wrecker" was absurd; but it was wonderful how those pebbles grew in a few days. Their size increased to almost the limit usually inserted in contracts for cobble-stone paving—"No stone that will not pass through a 6-inch ring to be used."

The "cub" was then invited out, first passing the block of wood and the lamp, and the windlass started again. "No go." It was then assumed that the curved cylinder bottom and under side of piston were not struck from the same center, and if so, might have caused a mismeasurement in getting the length of piston rod. To test this, small balls of clay were placed at intervals on the cylinder bottom, and the windlass again put into operation. But the crank would not go clear over. Upon re-entering the cylinder the balls of clay were found to be mashed to a uniform thickness, so disproving the last assumption. It was finally determined that the piston rod was *too long*, and had to be shortened. The excess of length was obtained by getting the *versed sine* of the angle formed by the crank when brought up, and when in a vertical position, and adding to it the clearance for piston. After some deliberation upon the best way to do this without taking the rod out, and sending it to the shop, this happy expedient was hit upon. The piston rod and crosshead were separated. Fortunately the hole in the crosshead was of uniform diameter, and the end of the rod had been reduced in diameter to give a shoulder for the crosshead to bear against. Then what is irreverently termed "an Irish lathe," was improvised. A sleeve was bored to fit easily the end of piston rod, and a cutter was secured to its lower edge. By means of two cross bars rotary motion could be given to the sleeve; this arrangement was then slipped over the end of the rod, and forced down by a screw, and turned, until the cutter had removed the desired amount from the shoulder.

Several times since, in my practice, I have found this device, somewhat modified to suit conditions, to be useful both on repairs and on new work. For example, truing up worn crank pins whilst in place, smoothing the outer ends of propeller shafts, and the like.

The engine was then connected and tried under steam, and gave very satisfactory results. It is stated by Chas. B. Stuart, in his book, "Naval and Mail Steamers of the United States," alluding to the "Mississippi:" "She has, however, been altogether the most useful and economical side-wheel steamer in the Navy, and has, it is believed, steamed a greater distance than any war steamer now afloat." After the steam trial the "cub" was sent to the shop in Philadelphia to make detail drawings for the workman, from Captain Ericsson's original drawings of engines for "Princeton," for which the contract had been made with Messrs. Merrick & Towne, Southwark Foundry, Philadelphia.

Fig. 1.

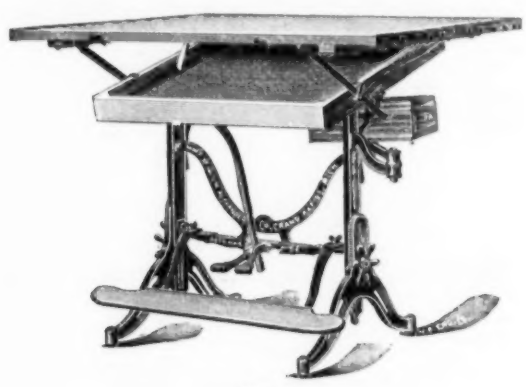


Fig. 2.

IMPROVED DRAWING STAND.

Fig. 1 shows it with cabinet of drawers and instrument table on a swinging arm, Fig. 2 arranged to be inclined from either side without inclining the lower portion of table, and Fig. 3 shows it as ready to be set aside and to occupy the minimum floor space.

The adjustment for hight is made in the standards at the side, and the table is held at the desired inclination by the brace seen in front. Most of the adjustments are made by the foot, and stooping down under the table to make them is reduced to the minimum. In fact, the hight of table and its inclination can be adjusted without moving from the stool.

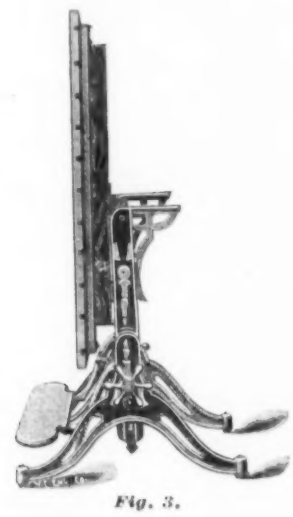
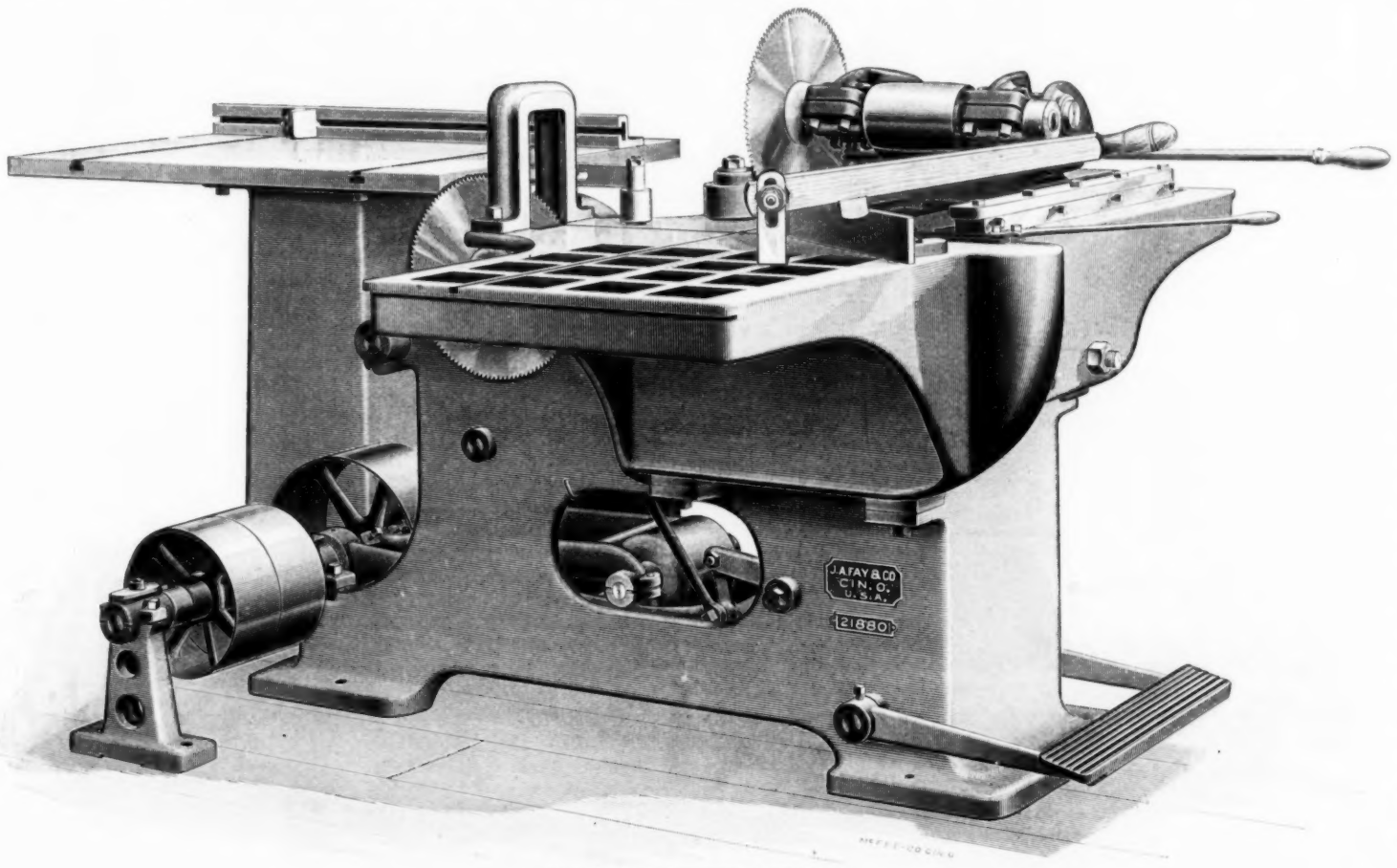


Fig. 3.

The tops are finished drawing boards, constructed in the best manner and with necessary provision for contraction and expansion.

The remainder of the woodwork is in oak and the frames are enameled iron. Three styles are made and the size ranges from 32 inches by 42 inches to 48 inches by 120 inches.

They are made by the J. G. Alexander Mfg. Co., Grand Rapids, Mich.



CAR BRACE CUTTING OFF SAW.

Drawing Stand.

We give on this page illustrations of a new stand for draftsmen. An inspection of the engravings will make its leading features readily understood, and it is only necessary to say that it possesses all the facilities of adjustment and all the conveniences now thought to be important in well equipped drafting rooms, and is made in a variety of styles to suit different requirements.

Car-Brace Cutting-Off Saw.

The accompanying illustration is of an improved machine for cutting off braces for the framing of freight cars and is designed to reduce the handling as much as possible and entirely does away with "laying out," and with preparatory cutting to length.

There are two saws that travel on slides at right angles to each other. The lower saw is mounted on a carriage that feeds automatically and is controlled by a foot lever, provision being made for maintaining uniform belt tension.

The other saw is mounted so that it can be adjusted vertically to suit different sizes of saws, and it is moved by the lever seen at the right.

When the angles are being sawn the work is placed against the fence seen, which can be adjusted for any angle. Suitable devices then hold it while the angles are formed.

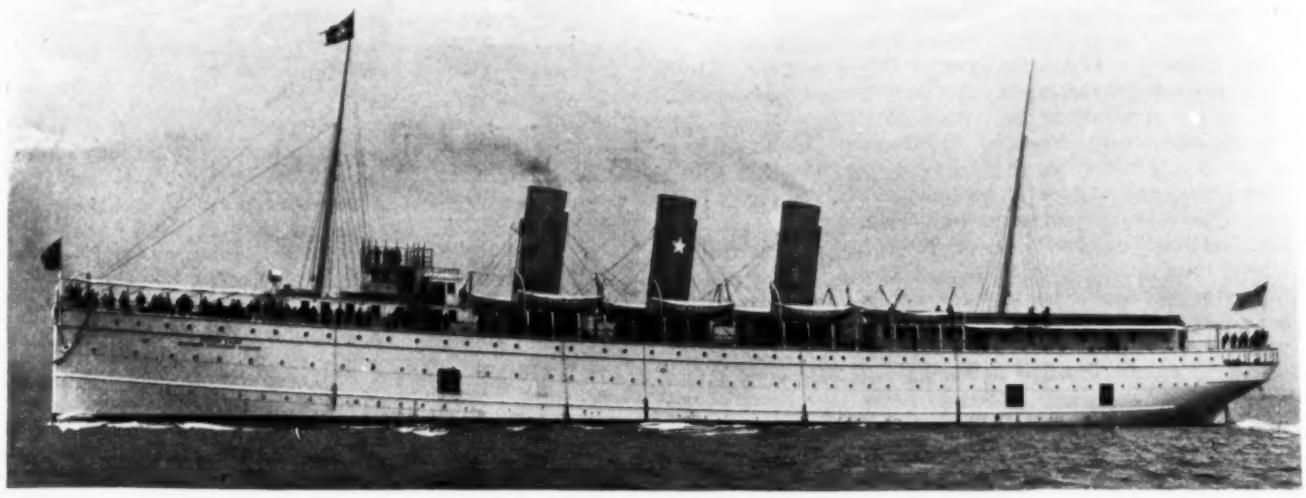
For regulating the length there is a supplementary table with T-slot in its face for setting a stop as shown at the left. It is designed to use saws 18 inches diameter.

The machine is made by J. A. Fay & Co., Cincinnati, Ohio.

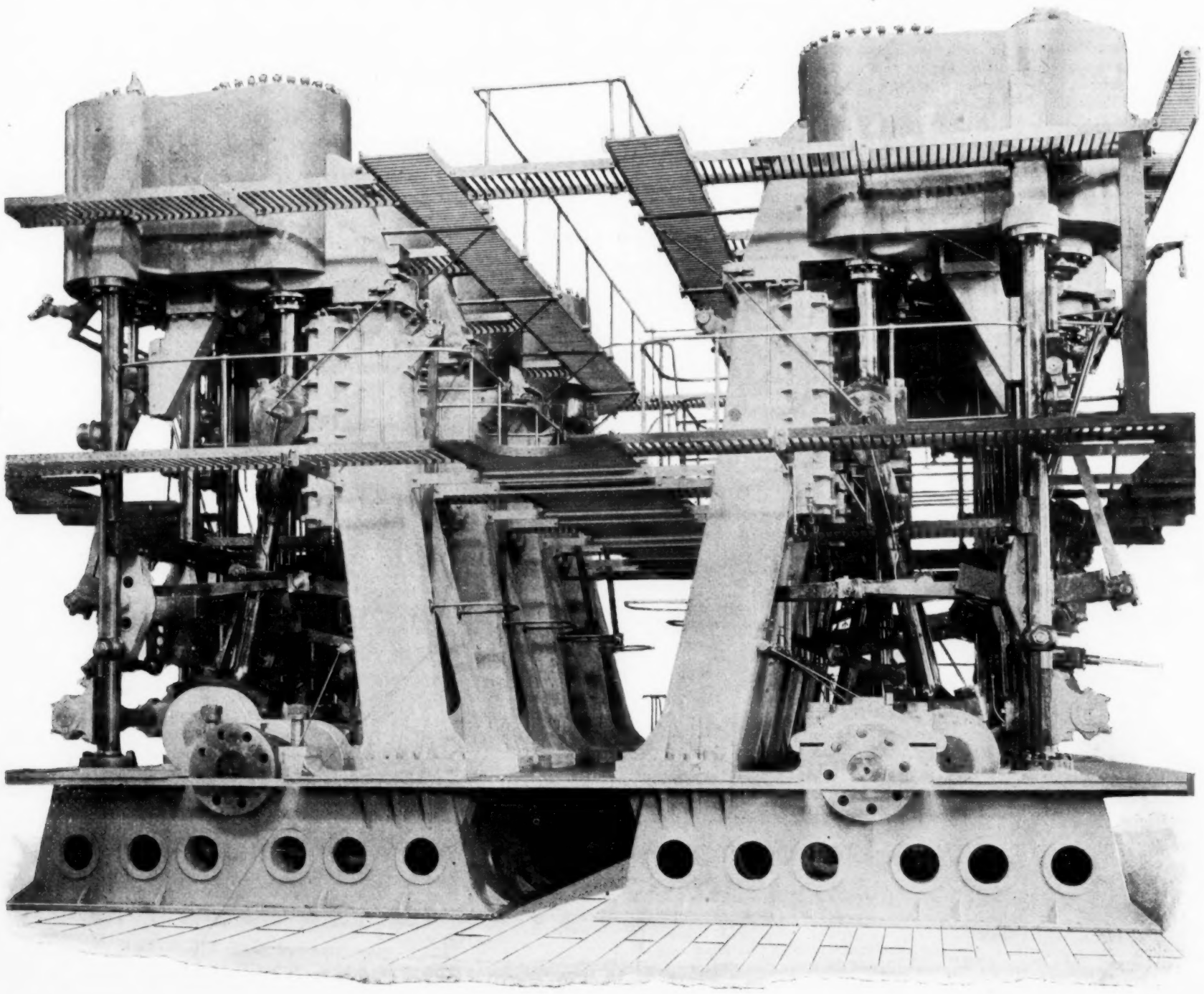
Mr. H. D. Gordon has resigned as master mechanic of the Juniata shops of the Pennsylvania Railroad, and will take charge of the engineering work of a leading supply house, which is said to be Jenkins Brothers.

Twin Screw Steamships "North West" and "North Land."

With this we give illustrations of the engines of the sister screw steamships "North West" and "North Land," built by the Globe Iron Works Co., Cleveland, Ohio. A description of the "North West" and her principal dimensions were given in our issue of July 12, 1894, but at that time we could not procure the illustrations. For easy reference we shall repeat some dimensions. Length of hull over all, 383 feet; length between perpendiculars, 360 feet; breadth, molded, 44 feet; depth, 26 feet; load draught, 14 feet; water ballast capacity, 682 tons; load displacement, 4,482 tons; tonnage, gross registered, 4,244 tons; tonnage, net registered, 2,340 tons. The two main engines are of the quadruple expansion type; diameter of high-pressure cylinder, 25 inches; first intermediate, 36 inches; second intermediate, 51½ inches; and low-pressure cylinder, 74 inches; stroke, 42 inches. Total indicated horse-power, 7,000. Twin screws, four blades each, 13 feet diameter and 18 feet pitch. The crank shafts are of wrought-iron of the built-up type, diameter of shafts 13½ inches; the crank pins are 14 inches diameter and 16 inches long. Solid couplings are forged to the shafts. The bed plate is made in four cast-iron sections, planed and bolted together. The thrust block is of the horseshoe type, with cast-iron shoes faced with babbitt metal, the sole plate is bolted to the bed plate. The cylinders are without jacket or liners, and the valve chests are connected by faced joints and turned bolts. Piston valves are adopted for all the cylinders, one for the high-pressure cylinder and two for each of the other cylinders. The valves are operated by the Joy valve gear and reversed direct by steam and hydraulic gear. The pistons in the high and first intermediate cylinders are of cast-iron, and those in the second intermediate and low-pressure cylinders are of steel, cone-shaped; all the pistons are fitted with single ring packing, and set out with flat bent springs.



TWIN SCREW STEAMSHIP "NORTH WEST."



ENGINES OF THE "NORTH WEST."

The machinery of the vessel embraces, all told, 65 steam cylinders, 26 pump cylinders, 6 centrifugal pumps, 6 fan blowers, 3 dynamos, one electric elevator, and a hand steam "steerer," as it is called.

Steam is furnished by 28 Belleville water tube boilers arranged in three groups. Steam pressure is 195 pounds, engine speed 120 revolutions.

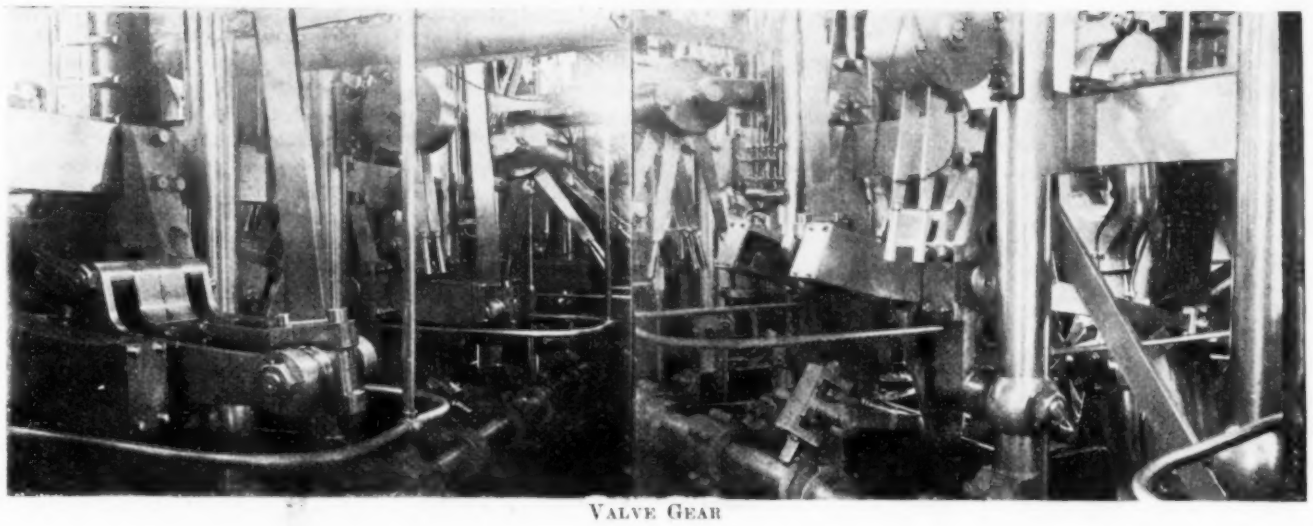
A special design of trunked-in coaling hatches is employed, the bottom of each trunk diverging in four inclined chutes to separate coal bunkers opening directly in front of the boilers, thus avoiding the labor and dirt of coal trimming and coal passing. Electricity is freely used, and a very complete ventilating and warming system, which is connected to air refrigerators as well as heaters, enables the occupant of each state room to regulate the air supply and the temperature of his own apartment independently. The fire room is very efficiently served by exhaust fans and is so thoroughly cooled as to be never uncomfortable.

The "North West" and the "North Land" formed in the season of 1895 a bi-weekly line between Buffalo, N. Y., and Duluth, Minn., each ship making the round trip in five days, making regularly about 20 miles per hour. They are built for passenger service only, and are magnificently appointed in the way of furnishing and decoration, and the vessels compare very favorably with the finest and most modern ocean steamships afloat.

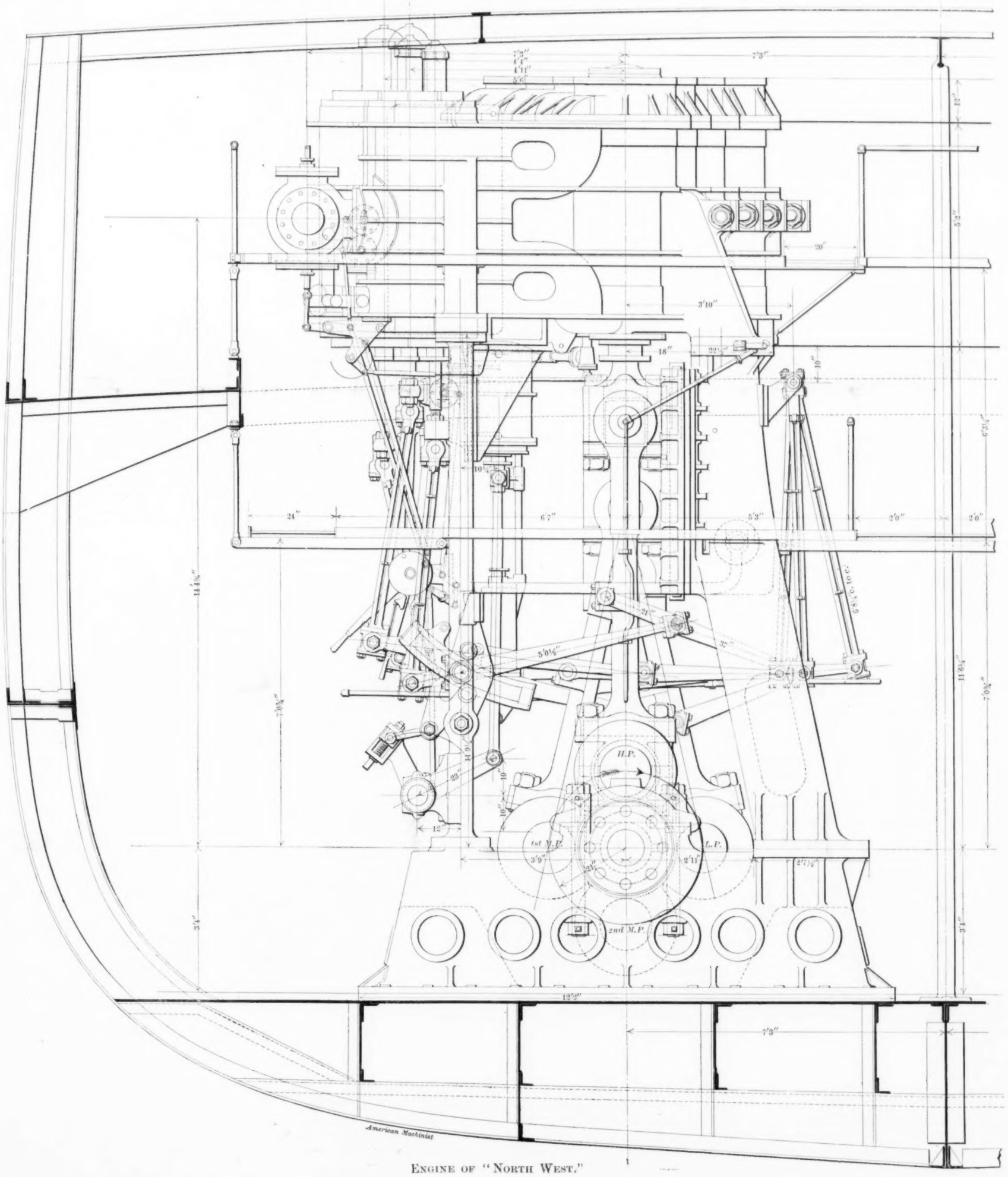
Mathematical Papers.

When Mr. M. N. Forney rises to discuss a paper during a meeting of a technical society it may be expected that he will say something worth listening to, and something of general interest. His special aversion is a mathematical paper, in which the author tries to cover the paucity of his knowledge of the subject by a mass of mathematical formulæ. He recently published in his journal, *American Engineer*, an editorial on this subject, from which we extract as follows:

It is, perhaps, not extraordinary that young students with the laurels of their graduation honors still fresh and green in their heads should write such papers; the grievance which those of us who are growing old and have had experience of more or less value is, that these young fellows insist



VALVE GEAR



ENGINE OF "NORTH WEST."

on reading such papers. We don't quite agree with *The Engineer* that they do no one any harm. Of course, if young fellows who know a great deal about mathematics, but have never studied the laws nor the limits of elasticity of an ordinary audience, choose to write and read such papers, no one has any good ground to interfere if due notice is given of their dire intention. The trouble is that they don't give such notice. We go to meetings with the placid expectation that some one who has done something that is creditable and well worth doing will read a paper and tell us of the difficulties he encountered, and how he overcame them, and what he accomplished, its value, and many other things that would be entertaining or profitable, and after a reasonable amount of time—say, 20 minutes—has been thus occupied, that then there will be a discussion in which the old fellows and the young ones will all tell, without boring their audience, what they know, or have learned, or want to know and learn of the subject in hand. Such proceedings are agreeable and refreshing, and we come away feeling strengthened for the struggle which must be renewed daily. Instead of this, what actually often does happen is, that some paper is announced with a taking title for a given meeting, which leads to the belief that the kind of diversion and instruction indicated will be dispensed. On such occasions it happens at times that some youth starts in on his manuscript. First he stands on one leg of a formula and then on the other. Then he gyrates about an hypothesis which he assumes to be a fact, and weaves a spider's web of integrations and disintegrations on the blackboard; he balances possibilities in learned figures of speech, until none who hear him can tell whether he is trying to prove that the toes of his boots represent the square root of his understanding, or the end of his coat tail is a function of his necktie. All we know is that what he is giving us is totally unintelligible to the hearer, and we have a strong suspicion that it is equally so to the reader. The authors of such papers are the chronic bores of technical associations. The reform which is proposed is that some committee should sit in judgment on the papers to be read. If they contain a little mathematics they should be designated by an X in their announcement, if more than a little by X Y, and if much by X Y Z, and then the said committee should provide cakes and ale in an adjoining room, to which members could retire while the author of the paper was practicing his vocal exercises and his mathematical gymnastics.

LETTERS FROM PRACTICAL MEN.

That "New Kink in Calipers."

Editor American Machinist:

I believe in calipers with as few kinks as possible. Those described by "Quirk" on October 24th are well enough to tell about and it is well enough to know about them, but they are not good enough for use. The idea is an old and familiar one that has been proposed and tried over and over again, but has never got into use because it costs more than it comes to. "Quirk" knows, when he thinks over the matter a little, that those calipers will not do what he claims for them. They cannot at one setting be used for both the roughing and finishing cuts. If the indicator is sufficiently sensitive to be of any value in finishing, the range of it cannot be sufficient to allow the difference that is needed between the roughing and finishing cut. If the entire range of the pointer was, say, a hundredth of an inch, it would not be enough for a finishing cut, because everybody knows that you cannot hold a cut of a half of a hundredth of an inch on common lathe work. And if the pointer had this range of a hundredth of an inch it would not be sensitive enough for very fine turning. In taking a finishing cut, too, it would not do, as "Quirk" instructs us, to have the pointer stop against the pin for the actual finishing size. Suppose you were turning a piece where you were taking a finishing cut that you wanted just right. The pointer would of course only operate or indicate anything when the work was too big, and then you would go to work and feed the tool in a little until you got down to size again, or until the pointer got back against the stop. But if your tool was fed in until the caliper pointer came to the stop, how could anybody tell that the tool was not in too far and turning your work too small? It might be an eighth of an inch too small, and the indicator would not say anything about it. Certainly for a finishing cut the pointer ought to be in the middle of its range, instead of against the stop. You ought to be able to know when you were too small as well as when you were too big. I do not mean by that that you should actually turn your work too small, but you ought to be able to know for sure that you were not turning it too small, or you ought to be able to know all the while just where you were at, and those calipers never would tell you. The reason, or one reason, it seems to me, why calipers like this have never made any headway in the trade is that just as soon as you take hold of them you have to begin learning the whole art of calipering all over again. The best lathesman in the world, familiar with the old style of calipers, and expert in their use, becomes an apprentice again at once as soon as he gets hold of those things. The thumb nut on the top interferes with the comfortable hold of the calipers the first thing, but the great and radical change in the mode of calipering is in the substitution of sight for touch in detecting variations. Of old time the eyes helped the hand to keep the calipers square with the piece so that they would caliper correctly, but they cannot do that any more, because they will have all they can do to watch the pointer, and it is hard to tell how the man will succeed in holding his calipers square any more. And then just think of turning a piece a couple of feet, or ten feet long, and having to get down where he can see the minute readings of that pointer. The calipers should have been provided with a mirror to bring the reading to the front and a magnifying glass to facilitate the reading. In these days of electrical devices the calipers might have been electrified with great advantage. Say that they had been provided with two electrical bells of different tones, and the pointer arranged to ring one bell when it moved a trifle in one direction, and the other bell when it moved the other way. We would have seen some extraordinary work if such calipers could have got into use. Of course the readings of the pointer on the "Quirk" "kink" calipers can have no fixed or definite value, as it must change with each size for which the calipers may be set, the angle of thrust, of course, varying as the sides of the calipers are opened or closed, so that they cannot be used for shrink fits or anything of that kind with any certainty of the result.

TECUMSEH SWIFT.

Commissions to Consulting Engineers.

Editor American Machinist:

It seems to me that the relations existing between the manufacturer and the consulting engineer are a little mixed, or, perhaps, not on a proper basis. It is undoubtedly to the interest of all concerned for the engineer to court the friendship and co-operation of the manufacturer, and I believe that it is equally desirable for the manufacturer to cultivate his relations with the engineer. This last does not appear to be a very common practice, except in cases where the engineer is the agent for the sale of the manufacturer's products. I have no hesitation in saying that the engineer is and should be such an agent, but not an agent in the ordinary meaning of the term.

If I had not known it before, my experience as an engineer would have taught me that I must of necessity purchase machinery for my clients, direct them where they can purchase, and recommend them to go to such and such places to have machinery built. In doing this I act as an agent, or rather become the agency, through which manufacturers obtain certain business. If I do this and afterwards speak to the manufacturer about the transaction, or some other similar transaction, I am quite certain to receive an offer of a commission on any business that I can turn over in this way. It is at this point that I draw the line. I do not resent such an offer, as it is quite natural for a manufacturer to be willing to make a reasonable compensation for that which gives him a profit, but I cannot help thinking that the relationship which brings about such an offer is on an improper basis.

A consulting engineer must make his business profitable or leave it for something else, but I cannot believe that he is justified in taking compensation from both sides of a transaction based upon his recommendation. In other words, the engineer should either be the agent of the manufacturer in selling his goods and take commission from him, or he should be the agent of the purchaser and receive his compensation in the nature of a fee for his services.

From these considerations I cannot help coming to the inevitable conclusion that a consulting engineer is not entitled to make any commission, profit or rake-off on machinery made or sold by his recommendations.

That some persons calling themselves consulting engineers do make a profit in this way is quite evident to me from the fact that I receive such offers myself. Doubtless such offers are usually made from a spirit of willingness to render an equivalent for favors received, but I cannot convince myself that I am entitled to accept them, and I am rather of the opinion that the majority of manufacturers think the same, if they think about it at all.

It does not follow, however, that there is nothing that the engineer can accept from the manufacturer, and that there is no equivalent to be rendered but what savors of bribery.

Every manufacturer knows, or should know, that there are many cases where it would be a benefit to his customer to get the advice and assistance of a mechanical engineer, and if he knows a good one he can recommend his customer there, and this recommendation will be a full equivalent for any business received through the engineer. It is for these reasons that I believe the manufacturer should take more pains than he usually does to know and properly estimate the independent engineer. He cannot afford to make a practice of recommending anything but a first-class man in this way, and he cannot be sure of his man unless he takes the trouble to familiarize himself with the different engineers and their methods of doing business.

C. L. REDFIELD.

Chicago, Ill.

Shop Expense—Shop Economy.

Editor American Machinist:

I believe that there must be more mechanics besides myself who would like to hear of some accurate and easy way to get at the shop expense—to be able to tell exactly every week "where we are at," so if a certain job should not pay all shop expenses, to keep shy of it at the next order.

In many shops the "one-third" scheme is practiced; that is, take one-third of the wages cost and you have the shop expense, but this does not seem to me to be satisfactory. Suppose a shop keeps a die sinker at $4 a day; he is using a $10 vise and probably his own chisels; counting on 26 days a month, one-third of his wages is about $34, which is his share of shop expense, compared with another man at next vise at $2 a day filing, using files all day, his share of shop expense is $17.

Next to them is a boy—running a $500 universal milling machine, spoiling $5 worth of sharp cutters a week—at $1.50 a day, one-third of which is $13, which is his share. This is hardly proportional.

It is the same with die makers and press boys. The die makers are generally kept for getting press work, and the press boys for making money.

The time cards would show that the toolmaker is hardly worth keeping. We pay the toolmaker at $3 a day, one-third of which is $26, while the press boy at 60 cents a day pays $5.20. Who is paying the shop expense?

It is plain that a job—an easy one—will cost one week more with a $2 man than next week with a $1 man, but if they are using the same tools the shop expense ought to be the same.

The cost of work will differ a great deal in spite of all time keeping. It depends a great deal on the mechanic doing it; the good, accurate all around man, quick but careful, and who doesn't believe in holding down a chair all day, generally pays his wages.

His next chair neighbor is also a first-class man—does his work right every time; but he hates to move around, wipes his chisel with a piece of waste before using it, and oils his vise twice a day. He might be all right on certain kinds of work, but better let him stick to the watch factory.

Then we have the hustler—the man graduated from a blacksmith repair shop; a small job comes in to drill two ½-inch holes and tap them in a piece of steel. The hustler is the man for that. He will grab the drill, run to the emery wheel and burn the point blue—no time to find the water bucket—and then start drilling at the fastest speed. It will run hot and squeal, but he will get those two holes all right. In tapping he will use oil if there is an oil can handy, but else not; the tap wrench doesn't fit and spoils the square, but it will do this job all right. This is the expensive man. Advise him to join the navy. He will show 15 minutes on his time card, say, 15 cents. But what is the actual cost? It will take a careful man 15 minutes to get that drill in shape again. If the "hustler" does it he will try to break off the point on the anvil, and most likely he will split the whole drill and hurt himself, too, and then the tap is half-way gone.

Next time "the good man" will get the job; he will fix things in good shape, write down 30 minutes on the time card, and the shop will think that they are losing money on him.

The shop expense depends on how shop economy is practiced, and the ways and means to practice economy in a shop are legion. There are many rules which, when enforced, look rather mean to us because we are not used to them, but if we reason right we will see that the more the shop saves, the more it makes and the more we are entitled to.

Look at the shop where the bag of cotton waste is thrown in a corner and all hands can help themselves. They will all take as much as they can carry, and spill and leave some at every machine that they are working at; next man will come along, but he won't use the old waste—he will throw it in a corner, where it is liable to catch fire, and where the insurance agent will spy it every time he comes around.

Then we have the oil barrel; every shop ought to have one man to fill the oil cans and oil the machinery. Let every man fill his own oil can and he will spill enough on his hands and can, not mentioning the floor, to oil his machine two days. But tell him that and he will have his opinion about you.

Taking good care of the machinery is good shop economy, hence lessens the expense; but how do the drill tables and lathe chucks look generally. The former "is only a hole," as a second-hand dealer expressed it, when bidding on one of these wrecks where the "hustler" had left his trade marks; and the latter is half turned away. I read an account somewhere about a man who was boring out a collar in a lathe, and in the meantime discussing politics with a man in the other end of the shop. He came back just in time to see the chuck drop on the floor; he had bored the spindle out of the chuck.

The narrator of this might have handled the truth a little carelessly, but it has a moral—"stay at your post."

A couple of years ago I was called to a town in Kentucky to rig up a tool room, as the manager suspected that the shop expense in this line was too heavy.

Many things looked queer to me. They

did not have any twist drills, but it took three blacksmiths and two helpers to keep their thirty men going with flat drills and chisels. A great deal of outside work was done, and the men used to pack into their tool bags whatever they saw fit without any account being kept of it. I suspected that they got tired carrying the tools home again, so I introduced the check system, giving every man 12 checks and let him leave one check in the tool room for every tool he got.

My greatest difficulty was first to create the tool room; to get all the tools together. Monkey wrenches were just as liable to be found on top of a beam as among the bolts. One wall was fixed with a number of hooks to hang the lathe dogs on, but this they used for drying their leaf tobacco. Lots of room on the floor for the dogs. Every machine was painted red, white and blue to the operator's best satisfaction; a lathe would have white head and tail stock, red bed and blue legs. Very patriotic indeed, but they would do better as a sign for a barber shop than in a machine shop.

The way belts commenced to drop accidentally around me when I stooped down or was looking for something in a corner, convinced me that the workingmen didn't appreciate my way of conducting a tool room, so I removed to a healthier country. P. D.

The Test of Roller Bearings.

Editor American Machinist:

Your favor of the 24th duly at hand, in which you ask for further information regarding details of the tests which we made on shafting, with and without the roller bearings referred to in your editorial October 17th. We already had an article prepared to submit to you for publication, if you deemed it worthy, for the benefit of those interested in the subject of shafting, friction and bearings. We will give you an outline of the tests made by us, and some details as far as they would interest your readers in a general way.

The first experiments were made by us at the works of the Wm. L. Gilbert Clock Company, in the early part of 1895, about April. At this time the subject of decreasing the friction of our machinery had been agitated for some time, and it was absolutely necessary to do something towards gaining power, but the company did not exactly want to put in a new wheel. We saw a cut and description of the Hyatt roller bearings in your paper, and immediately sent for a sample box. Upon seeing it, we ordered two more, and made some tests on a short line of $1\frac{15}{16}$ inches shaft. We made a test as to the difference of static friction, and found with this piece of shaft, which is about 20 feet long, running on three bearings, that it required a weight of 8 pounds 2 ounces fastened to the perimeter of a 24-inch pulley to start the shaft in motion while it was in the old babbitt boxes. When the old boxes were replaced by the three roller bearings, it was necessary to hang a weight of only $6\frac{3}{4}$ ounces to the same pulley to start the shaft in motion. We made a number of trials of this kind to satisfy ourselves that the difference was as great as it appeared to be at first.

After the officers of the company had investigated this sample test to their satisfaction, they decided to equip one full line with the boxes, and did so. This line took eleven boxes. The difference on this line was so apparent that it was decided to put roller bearings throughout the entire factory, as soon as it was closed for inventory and repairs. Before any rollers were put in, with the exception of the first three, we made brake tests with a prony brake to determine what amount of power we could absorb from the wheel, with the shafting running at a given speed. This we found to be 14.98 horse power. We made a large number of tests to obtain this result, and took the average, so that we consider 14.98 horse-power practically correct. After the roller bearings were all adjusted in place, another test was taken with the same brake, with the shafting, and everything connected therewith, running as nearly as possible under the same conditions, and we found we could absorb with our brake 22 horse-power, at the same speed as before; therefore the horse-power saved by reducing the friction of shafting in boxes was 7.02, which amount is 43.3 per cent. of the original available power. Since we had only 14.98 horse-power available for work with the old boxes, then the difference between that amount and the total power of the wheel, or 40 horse-power, was 25.02 horse-power, which represents the amount of power consumed by the shafting and belts. This 25.02 horse-power is 62.55 per cent. of the total power of the wheel wasted in friction, etc. With the roller bearings we had available 22 horse-power, which amount subtracted from the total power, 40 horse-power, leaves 18 horse-power, which is 45 per cent. of the total power consumed by friction, shafting, belts, etc. We save 7.02 horse-power, and it originally required 25.02 horse-power to drive the shafting, etc., hence the per-centage of power saved is 28 per cent.

At each one of these tests all overhead machinery in the factory was running. Up and down belts, which run small machinery, and their countershafts were thrown off. There is in all about 600 feet of shafting, running in 104 bearings. This is divided up into nine different lines of from 30 to 150 feet in length, besides a jack shaft and gear shaft, which connects the water wheel with the other shafting in the factory. There are ten belts, varying in width from 5 inches to 20 inches, which drive the various lines. After the plant was ready to run with the roller bearings, the writer was able by taking hold of a 35-inch pulley to turn the entire 600 feet of shafting with its ten larger belts, to say nothing of the numerous small ones; also the water wheel and gear shaft which was attached at the time. . . .

The Strong Manufacturing Company, of this town, have put in the rollers since this plant was fitted up, and from their indicator cards taken from their steam engine before and after putting in the rollers they found that their saving is over 40 per cent. These indicator cards may be seen by anyone who will call at their factory and ask for their chief mechanic, Mr. Chapman.

If there is any other information regarding details of our tests which any of your readers would like to have, we shall be very glad to furnish them for the asking.

T. W. R. McCABE.
GEO. B. WOODRUFF.

Winsted, Conn.

Strength of Hydraulic Cylinders.

Editor American Machinist:

In your issue of October 3d, you give rules, in Questions and Answers, for the thickness of cylinders to withstand hydraulic pressure which might mislead the person they are intended for.

The formulæ given are correct enough, and the first, as you state, is the best because the simplest; but it is still simpler and answers all practical purposes to leave out $-p$, that is, write it thus: $\frac{p \times r}{s}$; where p = working pressure, r = radius of pipe or cylinder and s = the strain per square inch thought to be safe on the material, for instance: Required the thickness of a hydraulic cylinder 10 inches diameter to stand a working pressure of 1,500 pounds per square inch. Then $\frac{1,500 \times 5}{3,000} = 2.5''$, or in such cases $\frac{D}{4}$ = required thickness, when D = diameter and 4 constant derived from the other or first formula; therefore $\frac{10''}{4} = 2.5''$.

But the strains you advise will not stand in practical work, as I know from experience; 3,000 pounds per square inch is the maximum that should be put on cast-iron; 4,000 pounds per square inch may safely be put on good cast-brass, and 10,000 pounds per square inch is the limit on cast-steel.

Steel makers on work up to 6 inches generally require to have them as thick as what would serve in cast-iron, or they will not take any responsibility. There is not a steel firm anywhere that would undertake to cast a steel cylinder 10 inches diameter, 0.123 inches thick for a working pressure of 786 pounds per square inch, or even to hold water at no pressure but that due to its own head.

More depends on the closeness of the casting than anything, as in a properly designed cylinder the fear of bursting is not due so much to any determined strain as to the fear of an open metal that soon becomes "saturated," then all calculations are upset. I have known cylinders and pipes stand for years and then "go," to the astonishment of the owner. The constant water hammer, of course, somewhat crystallizes the metal, but saturation through any pin hole will do more destruction in six months than water hammer would do in six years.

Again, a brass or bronze may show a tensile strain of 40,000 or 45,000 pounds per square inch and be absolutely useless for hydraulic purposes, as it may, and generally is, open or porous. I have used the above rule for 25 years, and have cast thousands of cylinders and pipes from it, but circumstances in all cases have to be considered, and some cylinders of cast-iron would not have to have more than 1,000 pounds per square inch put on them if they are wanted to stand any length of time.

As a 9-inch ram of any length of stroke and working through a gland would have a cylinder 10 inches diameter to allow clearance for the ram, then X. P., of Louisville, Ky., would better make his cylinder, if cast-iron, at least $1\frac{1}{8}$ inches thick; if of brass, 1 inch thick, and if of steel it would have to be at least $\frac{7}{8}$ inch thick if short, and 1 inch thick if long, to be sure of getting a good casting, therefore he would get a cheaper and perhaps a more satisfactory job to have it made of cast-iron, which would answer well enough for such a pressure.

ERNEST W. NAYLOR.

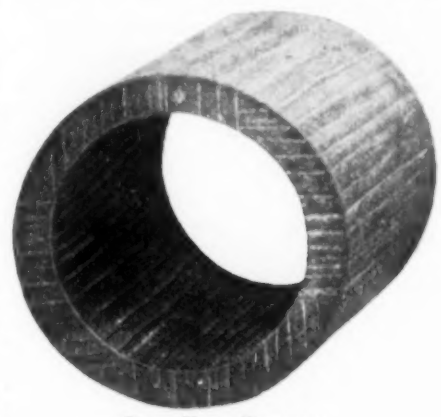
Bound Brook, N. J.

Raw Hide Bushing.

A new substance for the lining of journal bearings is represented by the accompanying illustration. It is raw hide which is put together in strips by the process employed by its makers in the manufacture of raw hide pinions, etc., and in cases where pressures and speeds are moderate it is found to work well entirely without lubricant. This it is thought will make it useful for bushings in loose pulleys of machine tool countershafts, and for similar service where the cost of throwing off belts and oiling, with the necessary stoppage of the tool while it is being done, is of some importance. Then there are other places where oil is objectionable for various reasons.

The raw hide of the bushing is treated with oil during manufacture, and oil will not injure it, but, in fact, is recommended to be used where pressures or speeds are high.

They are furnished in standard sizes, and



RAW HIDE BUSHING.

are designed to be simply pressed into place and then reamed out.

The manufacturers are the New Process Raw Hide Co., Syracuse, N. Y.

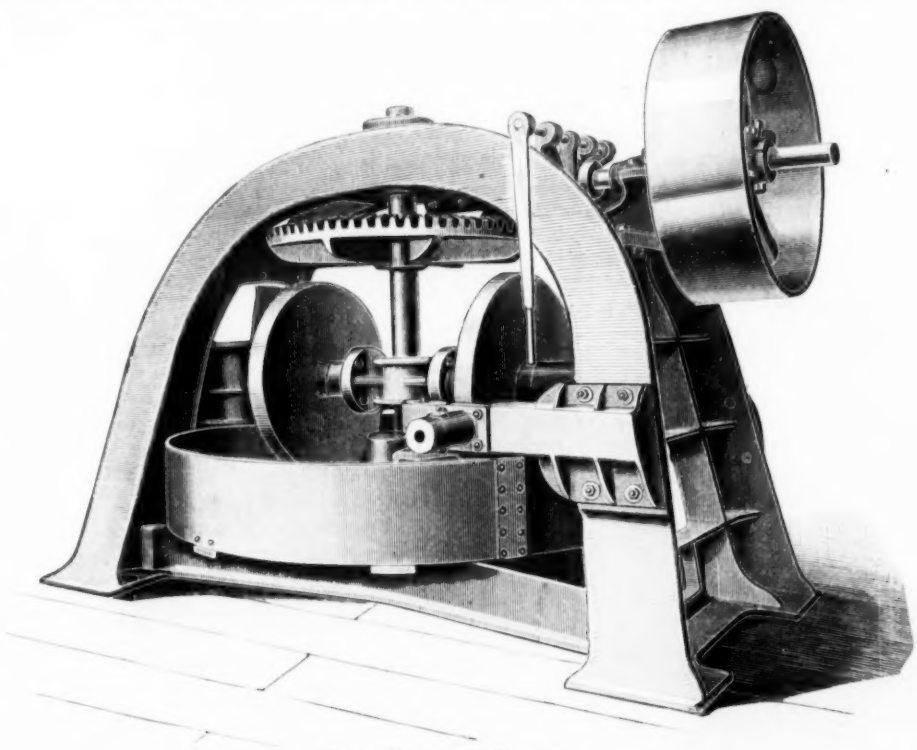
Clay Grinding and Mixing Machine.

We present herewith an engraving of a machine for grinding and mixing clay for use in various lines of manufacture, such as terra cotta, etc. It will grind fire brick material, shale, coal, bone, etc.

The particular machine illustrated was built for the terra cotta works of Wm. Galloway and is designed to do heavy work continuously.

The machine is entirely self-contained, and the design of the frame is such as it is thought will secure greater durability and more satisfactory working than are common in this class of machinery.

The machine has a capacity to grind from seventy to ninety tons of clay per day. The central shaft is 8 inches diameter and runs on a hardened steel bearing at the bottom. The crushing rolls are four feet diameter and weigh about 3,000 pounds each. The total hight of the machine is 10 feet 6 inches and its width 14 feet. The pan in which the material is placed is 9 feet diameter.



CLAY GRINDING MACHINE.

The machine is built by Jos. Crossley, Trenton, N. J.

It looks now as if the familiar pilot boats that have so long met vessels coming into this port will be replaced by small steamers, which, it is thought, will do the work more economically. It may be much questioned, however, whether on the whole they will be safer, and certainly they will be less picturesque, though that will not count for much.

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Aids to Skill and Substitutes for It.

A recent writer in our columns laments that the common calipers, such as the lathe-man uses in every machine shop, have not been improved in forty years. They have not been improved because the possibility of improvement was eliminated long ago. The statement that two and two equal four has not been improved for a millennium. There is only one way to improve the instruments that depend upon the personal skill of the operator for their successful use, and that is to simplify them. If the thing was reduced to its simplest terms a century ago, that ended the matter for all time. There is a process that is continually going on which is often characterized as the devising of aids to mechanical skill. The fact, however, is that we too often characterize as aids to skill what are really substitutes for it. The bell-punch which the street car conductor carries, or the gong and dial that he manipulates on the car, might be called aids to honesty, but the fact is that honesty is no longer of any account in the arrangement. Nothing was thought to be more essential than honesty in the collectors of fare, but honesty was found to be rather scarce, and the revenues of the companies have been increased by the substitutes for honesty that have been devised. So the accuracy and value of the products of our shops, that were once contingent upon the personal skill of the workman, are now advanced by the substitutes for personal skill that are being devised continually. The distinction between the device for aiding or augmenting personal skill, and that which provides a substitute for that skill, is clear enough in the case of the calipers before referred to. Two simple jaws connected by a rivet enable a skilled workman to measure the diameter of a shaft in the lathe, or to detect differences in the diameter, with very minute accuracy. In this case the sensitive fingers of the man, and the mental mechanism behind them, are the real agencies in making the final determination. If we now put upon one jaw of the calipers, as proposed, a movable end with a light pointer, of greatly magnified movement, we may trust to this indicating pointer to tell us the exact diameter of the piece when the caliper is passed over it; but it will do this in the hands of an unskillful man practically as well as in those of a skillful one, and skill counts for little or nothing in this operation, if the improvement upon the caliper works as it is assumed to work. This operation of devising substitutes for personal skill is going on continually, and generally with better results than in the case of the improved calipers. In most cases the substitution is a practical gain; but it should be understood to be just what it actually is.

The turret lathe, the screw machine and kindred tools can scarcely be said to come precisely under either of the preceding categories. They are neither aids to skill, nor substitutes for skill, but rather concentrators of skill, or they apply a concentrated skill to the operations of the shop. Memory easily goes back to the days, not very long ago, when none of those tools were in existence. In those days if an engine was under way every individual bolt, or stud, or set screw, or what not, was made separately in the engine lathe. The iron would be cut off, or the forging made, roughly centered and roughly faced to length, then re-centered, drilling the centers, and ends faced again, turned to size with probably two cuts, thread tool ground to gage and set, threads cut, end of thread rounded off, etc. Many operations were involved, all requiring considerable skill, and at the last careful manipulation as to size. The preparation and adjustment of tools and dies in the modern tools requires higher skill and greater care than was required by the old system, but it is now so concentrated that one exercise of that skill suffices for the production of thousands of pieces. Somewhere the skill must still exist, probably as keen as ever it existed in the history of the world, but perhaps not so much of it, or so wide a range of it, in any single individual.

Dirt in the Shop.

It would seem that the full significance of the familiar definition of dirt as "matter out of place" is seldom rightly apprehended. Under the definition anything may be dirt in some place, while nothing can be dirt in every place, because there is a place for everything, and it is only when that place is unoccupied that something is elsewhere masquerading as dirt. Dirt is an abnormal condition of matter. If everything were in its place there could be no dirt in the world, and therefore it is that the term dirt is always one of reproach and depreciation. Though dirt is an abnormal condition, there is still more of it than we usually recognize. We are too often in the habit of thinking that cleanliness may be compatible with disorder, but this is evidently impossible, as the terms are contradictory. The having a place for everything, and the keeping of everything in its place is simply cleanliness.

If anyone should be clean by instinct and in practice it is the shop foreman. As the housewife should be ashamed of dust on the piano and mud on the kitchen floor, as inimical to health and restful comfort, so should he be ashamed of everything in the shop that is not essential to its orderly and profitable operation. The difference in shops in this respect is evident to an experienced eye the moment the door is opened. A clean shop, under our exhaustive definition of cleanliness, may give the idea of roominess, and seem to be a place where free and easy movement is possible entirely without regard to the size of it, and this will always be the place where we shall expect to see the best and the most work turned out. The shop that is crowded and cluttered up with finished and partly finished work, and with castings or material other than that immediately in use, or immediately to be used, is constantly working at a disadvantage. No shop can be so big that inconvenience and additional expense of operation will not result from ignoring the imperative conditions of a liberal cleanliness. If we take a moment to consider the matter in detail we can easily understand how it may affect and hinder the individual workman to be overcrowded and hampered in his movements around the machine that he is operating, and to have his mind distracted by the presence of things with which he has no present concern. We generally recognize the necessity of securing the common conditions of comfort for the men, but few of us include them all. The first point of all to receive attention is probably the temperature of the place, and next to that the light. Some go no further. The purity of the air is seldom thought of, the freedom from distracting noises is almost completely ignored, and the absolute freedom of movement is often unnecessarily destroyed. The foreman is not always, or, perhaps, even generally to blame for having an overcrowded and disorderly shop. The foreman, as many of them know to their sorrow, is as often in the position of a scapegoat as he is in that of a responsible and independent manager of a department. He too often is not allowed to have things as they should be, while he is readily blamed for having things as they are. No shop is so small that, in the interest of cleanliness and freedom, it does not require a considerable space to be used for storage purposes exclusively, while many shops that are not small are practically without any space available for or devoted to such purposes. One mistake as common as any is in crowding into the shop indiscriminately and as rapidly as possible the material for future work. The idea seems to be that the faster the stuff is sent in the faster the work will be crowded out, like feeding sausage meat to a machine. It does not work that way. You can choke a machine so that it will not work at all, and it should be possible when this thing is overdone to choke the shop so that it would stop, and this might lead to some reformation. The desire to choke some one under such circumstances has often arisen.

One of the most frightful accidents of recent times is that which took place in Detroit on the 6th, where a boiler which was in the basement of the *Evening Journal* building exploded, wrecking the building and causing the death of about forty persons and injuring many more. At this writing not much if anything is definitely known as to the cause of the explosion, and its exact cause may never be determined, but one thing can be said of it without reservation, and that is that the explosion and frightful loss of life were needless. It cannot be said of such an occurrence that it is "sometimes unavoidable," or that "such accidents will occasionally take place in spite of every precaution that may be taken to prevent them." On the contrary, it can be said without any reservation whatever that such an explosion can be absolutely prevented, and it is the duty of a community to see that they are prevented. About twenty years ago a boiler exploded in Philadelphia, killing a number of people. The calamity aroused public sentiment, the Franklin Institute became interested, and the result was a city law regulating the use of boilers and providing for their inspection, which is probably the most strict and at the same time better than can be found in any other American city.

It is probable that Detroit will now have an ordinance that will prevent such explosions, and the wonder is why each city must pass through its own experience and learn its own lesson, refusing, or at least neglecting to learn from the experience of others.

We have before noted the idea of a Chicago man to make the objectives of large telescopes in sections, instead of a single piece of glass. We made some investigation of the matter, however, which satisfied us that there was nothing in the scheme. It is now announced that representatives of the Proctor Memorial Association at San Diego, Cal., have investigated the matter, and will report in favor of adopting that plan for a telescope to have at least five times the power of the Lick or the Yerkes telescope. In this connection it is said that the inventor thinks the telescope should not be mounted in dome, "as much more power can be obtained from any telescope when the same is properly mounted in the open air." This last, we feel quite sure, is nonsense, and it has the flavor of a fake. Large telescope building has not been entirely isolated from land booming in California in the past, and there are those whose prophetic eye can see great possibilities in the line of selling corner lots to purchasers who can be made to believe that the moon is to be brought to within twenty-five miles of them.

The figures of Admiral Ramsay, which show that our new naval vessels do not habitually cruise about the world at their utmost possible speed, are being treated as though they represented a real discovery of something not known before, and something of the utmost importance. Probably most of those who are commenting on the figures never thought much about what the vessels are in the habit of doing, but in case they should think anything about it we wonder if they would expect them to always move about "tuned up to concert pitch." We thought that nearly everybody understood that trial trip speed only shows what a vessel is capable of when every possible effort is made to attain the greatest possible speed, regardless of economy and almost regardless of the welfare of the machinery. We know of no fairer or better way of testing the speed capacity of naval vessels than that which is now generally followed, and it is probable that in most cases the speed attained during the trial can be reached again by the same vessels under like favorable conditions, or when it is required.

The ram "Katahdin," built by the Bath Iron Works, seems to have attained the distinction of being the only vessel of the new navy that has distinctly fallen short of the contract requirements in regard to speed, her corrected speed being 16.11 knots, instead of the 17 knots required by the terms

of the contract. Though the contract requires that the vessel be rejected on this account, it is thought that this will not be done because considerably over the stipulated horse-power was shown by the engines, and the deficiency in speed is thought to be due solely to faults of the model for which the builders are not responsible.

The case naturally brings up the question of how much responsibility should really be assumed for either speed or horse-power in such cases, where the vessel is designed by the Navy departments. It would seem as if the common sense view of it would be that if the designs are carried out and the workmanship is good that should end the builder's responsibility. The present plan looks like holding the builder responsible for matters over which he has little or no control.

Commodore Tryon, Surgeon General of the Navy, calls attention in a recent report to the effect of the overheated fire rooms of many of the modern naval vessels. The temperature ranges as high as 189° Fahr., in some of them, and 124° Fahr. seems to be about the lowest temperature to be found in them. There have been numerous prostrations in the engineer corps from this excessive heat.

William Canam, superintendent of the steel mill of the Bethlehem Iron Company, one of the best known ironmasters in the country, died recently at Bethlehem, Pa. Mr. Canam was 67 years of age. He rolled the first rail turned out of the works, and for thirty years was associated with John Fritz, who built and constructed the plant.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(399) F., Cidra, Cuba, asks: Is there anything I can mix with the water in a hydraulic press so as to prevent rusting of its parts and attacking the brass? Pressure is 3 tons per square inch. The liquid is not to be re-pumped as in a press, but will be used for a grind mill. *A.*—We believe that petroleum mixed with about 30 per cent. of sperm oil will answer your purpose.

(400) H. W. L., Holyoke, Mass., writes: Please advise me as to where I can get a book or information relating to the construction and working of the Corliss valve mechanism. *A.*—You will probably get the information desired from the book entitled "Valve-Gears for Steam Engines," by C. H. Peabody, published by John Wiley & Sons, 52 East Tenth street, New York. This book contains not only a description of the Corliss valve gear but many other types found in everyday practice.

(401) J. Y. M., Richmond, Va., asks: Why is it that a wheel under a railroad freight car can be slid easier at a speed of 2 miles per hour than at a speed of 10 or 15 miles per hour? I have frequently noticed in freight trains coming to rest that the wheels revolve (brakes applied) until a speed of 2 or 4 miles per hour has been reached, and then the wheels commence to slide. Why is this? *A.*—At the higher speeds the brakes will have to overcome a greater momentum than at a lower speed, hence at low speeds the wheels will slide easier.

(402) W. R., Galt, Canada, asks: What chemicals are used with an alloy of copper, tin and antimony, generally called babbitt metal, to cause it to flow freely? I find that the copper prevents a free flow when casting a bearing. The alloy is made from what is considered to be one of the best formulæ. *A.*—There are no chemicals used for this purpose. Your trouble is probably due to chilling the metal in pouring. The bearing or whatever the babbitt metal comes in contact with should be kept warm. Sometimes a little oil put on top the metal before pouring will have a beneficial effect; of course care should be taken that the metal is not so hot as to cause the oil to ignite.

(403) A. K., Allegheny, Pa., writes: Please give me a rule for computing the weight of steam per cubic foot at different pressures. *A.*—The following empirical rule may be used: Raise the given absolute pressure in pounds per square inch to its .941th power and divide the result by the constant 330.36, the result will be the weight in pounds per cubic foot of steam under the given pressure. In symbols we have

$$D = \frac{p^{.941}}{330.36},$$

in which D = weight of steam in pounds per cubic foot, and p = given absolute pressure in pounds per square inch. To raise the absolute pressure to its .941th power find the logarithm of the pressure and multiply it by .941, the result will be the logarithm of the power, and then find the number corresponding to this logarithm. To find these logarithms you will need a table of logarithms of numbers which are given in many of the engineers' pocket-books. In these you will also find tables giving the weight of steam, hence a calculation is not necessary.

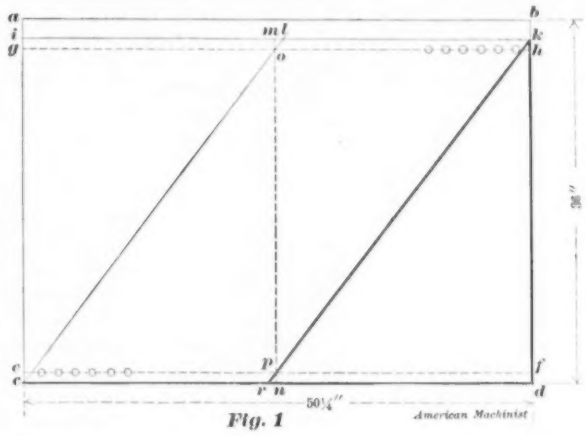


Fig. 1

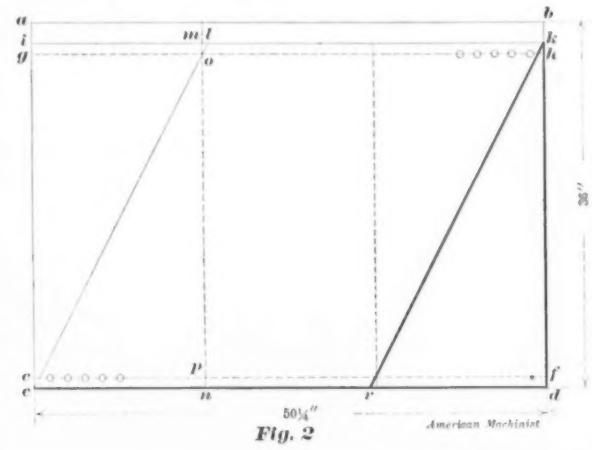


Fig. 2

(404) A. B., Jeffersonville, Ohio, writes: I am informed that a one horse power engine can raise a weight of 90 pounds at the rate of 4 miles per hour. Is this correct? *A.*—It will have to be a well built engine to do that amount of work. To raise a weight at a rate of 4 miles an hour is equal to a speed of 352 feet per minute; now multiplying 352 feet by 90 pounds, and dividing the product by 33,000 gives us,

$$\frac{352 \times 90}{33{,}000} = \frac{31.680}{33{,}000} \text{ horse-power,}$$

which leaves a very small margin for overcoming the resistance due to friction. 2. Is there any locomotive that weighs 90 pounds per horse-power? *A.*—We do not know of any locomotive which weighs so light as 90 pounds per horse-power, the weight is nearly double that amount. 3. If a locomotive can raise a weight 90 pounds at the rate of 4 miles per hour per horse-power, and weighs 90 pounds per horse-power, could not a locomotive raise its entire weight at the rate of 4 miles per hour? *A.*—No, not even under the conditions given, as there will not be sufficient power for the amount of work, and for overcoming the resistance due to friction. But as stated above, a locomotive weighs much more than 90 pounds per horse-power, and therefore a locomotive cannot raise its own weight under the conditions named.

(405) F. G., Chattanooga, Tenn., writes: Kindly answer the following question, which may be simple to you, but it is complicated to me. I have a 10-inch spiral pipe to make 80 feet long out of ¼-inch steel. The sheets are 36 inches wide, 50¼ inches long. I cannot get it into my head how to start it, as I never made one nor have I seen one close enough to examine it. I wish you would explain how to get the taper, etc., and give a little sketch of it. *A.*—Let *a b c d* be the given sheet; the edge *c d* we shall assume to be perfectly straight. Draw the center line *m n* perpendicular to *c d*; draw the center line of rivets *e f*, if the rivets are $\frac{5}{16}$ inch diameter, which we believe to be correct for a ¼-inch sheet, then the distance between the line *e f* and the edge *c d* should be 1 inch; the line *e f* cuts the center line *m n* in the point *p*; from this point lay off the distance *o p* equal to the circumference of the mean diameter of the pipe, that is, the circumference of a circle 10¼ inches diameter which is equal to 32.2 inches. Through the point *o* draw a line *g h* parallel to *e f*, and at one inch above the line *g h* draw the line *i k*. Through the points *e* and *o* draw a straight line *e l*, and through the points *p k* draw a line *k r*, which, of course, must be parallel to the line *e l*. Cut the sheet to the lines *e l*, *k r* and *l k*, then *l k e r* will be the required shape for one spiral course of the pipe. In rolling this sheet, the line *e r* or *l k* should be kept parallel to the axes of the rolls. When rolled correctly, the pipe will be 10 inches inside diameter, and if all the courses are the same diameter the spiral joints will be butt joints. This construction gives the greatest pitch of spiral that can be cut out of the sheet. Instead of dividing the length of sheet into two equal parts, as in Fig. 1, we may divide it into three equal parts and then proceed as before, as shown in Fig. 2. Or we may divide the length of sheet into greater number of equal parts and still have spiral joints, and thereby not cut so much of the iron to waste. From this it will be seen that all depends on the pitch of the spiral, which you have not given, and when that is known then make the distance between the lines *e i* and *m n* equal to the pitch and proceed as before. 2. In Question 375, you give a formula for computing the bursting pressure of a dished head, the first I have ever seen in any periodical. I would like to know how you get the constant 4, and will this rule apply to any thickness and any diameter of head? *A.*—In computing the resistance of a sphere to internal pressure we use the same formula as is employed for computing the transverse resistance of a cylinder. Thus the total pressure in pounds on a cylinder head, whether flat or spherical, is equal to .7854 multiplied by the square of the diameter in inches, and by the pressure in pounds per square inch; or in the symbols we have, the total pressure on the head = $.7854 \times D^2 \times P$, in which D = diameter of the cylinder, and P = pressure in pounds per square inch. The resistance to the total pressure on the head is equal to 3.1416 multiplied by the diameter and thickness in inches, and by the working stress of the metal in pounds per square inch. In symbols we have $3.1416 \times D \times T \times S$, in which D = diameter of the cylinder as before, T = the thickness, and S = stress per square inch. Now, the resistance must be equal to the total pressure on the head, hence we have,

$$.7854 \times D^2 \times P = 3.1416 \times D \times T \times S,$$

which reduces to

$$D \times P = 4 \times T \times S. \qquad (1)$$

The formula referred to in answer to Question 375 is,

$$P = \frac{S \times 4 \times T \times d}{R^2 + d^2} \qquad (2)$$

in which d = depth of spherical part of head, and R = its radius. From formula (2) we get

$$P \times (R^2 + d^2) = S \times 4 \times T \times d.$$

When d attains its maximum and is equal to R, the dished end becomes a hemisphere, and the above formula reduces to

$$R \times P = 2 \times T \times S. \qquad (3)$$

If we now replace the radius R by the diameter D, we get,

$$D \times P = 4 \times T \times S,$$

which is the same as formula (1). Formula (2) is applicable to boiler heads of any diameter, and in which the safe pressure does not exceed, say, 500 pounds per square. If the pressure is much greater than this, so that the thickness becomes comparatively great with the radius, then formula (2) is not a safe one to use.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 912.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patent Solicitor. J. G. D. Mack, Madison, Wis.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engrs. should investigate the Korting Condenser. Obtain Catalog from A. Aller, 109 Liberty St., N. Y.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill, 913 Tilden street, Saginaw, Mich.

A book useful to engrs. & steam users, "Hawkins' Instructions for the Boiler Room." $2.50. Catalog free. Theo. Audel & Co., 91 Liberty street, N. Y.

Thin emery wheels, for cutting slots, etc., a specialty. The Tanite Co., Stroudsburg, Pa.; 161 Washington street, New York; 139 East Pearl street, Cincinnati, Ohio.

"Practical Drawing," by J. G. A. Meyer; used by engineering schools in lieu of text book; the set of 92 papers sent to any address in the United States for $5. AMERICAN MACHINIST, 203 Broadway.

Bicycle Tools—VI.

STEEL RIMS.

The steel rim was supposed by almost all cycle makers to have gone never to return to popular favor, with the opening of the season of 1895; it still had some purchasers, yet the tide of popular favor ran so strongly in the direction of wood that 98 per cent. of the July orders of one large Indianapolis cycle shop were for wood rims; but this same concern with no effort on their part to favor the use of metal rims found their August orders suddenly change to only 90 per cent. wood rims instead of the previous 98 per cent.

Gormully & Jeffery report also a large, and by them wholly unexpected, increase in steel rim orders at the close of the summer season

The metal rim is very much stronger in every way than the wood rim, and has the very great advantage of being entirely unaffected by moisture. The rim of the cycle wheel in use is subject to daily and often hourly wettings which would effect the complete destruction of a glued up wooden structure not thoroughly protected by varnishing of the very best description; even when the best of varnish is used and applied with the utmost skill, the drilling of the spoke holes, which is always done after varnishing, opens the wood to water in a way to greatly endanger the stability of the glued joint, which is the sole dependence of every wood rim made. The Plymouth shops (Indiana Novelty Co.) have a new idea which is just now being offered the public for the first time, in the way of a metal eyelet which is flanged over the spoke hole in the wood rim both outside and inside, and not only gives effectual protection against the entrance of water at the spoke holes, but also makes a handsome finish on the inside of the rim, and this metal eyelet or bush may add greatly to the life of the wood wheel rim by defending it from wet, and so obviating the cause of its greatest danger. The favor with which the wood rim has been received is one of the many curiosities of cycle manufacture. The old velocipede wheel was almost invariably of wood throughout—hub, spokes and felloes, with a steel tire; there were a few examples, however, almost from the first, of steel velocipede wheels. With the revival in the form of the high "ordinary," the use of the metal rim became exclusive, as might have been expected in case of metal hub, wire spoke wheels from 50 to 64 inches diameter, which were to be as light and strong as possible and carry a solid round rubber tire. Thus the first wooden wheels were displaced by

all steel wheels, and no one would have dreamed of wood being again an almost universally employed part of the cycle wheel; yet with the season of 1894 the wood rim was largely in evidence: a pair of wood rims are from three to five ounces lighter than steel rims of the same diameter; and the wood rim, while it may break under a sudden blow, does not assume that distressingly grotesque form by which a "buckled" steel rim relieves itself of spoke tension. The probability is, apparently, an almost equal balance between the respective merits and demerits of the wood and steel rim, and it seems quite possible that each may have its admirers, and both continue in use for a long time before either is finally banished from favor.

Fig. 40 is a sketch from memory of the first "Columbia" rim, the solid rubber tire being about one inch diameter. The rim was made of angle-steel, with the spoke holes drilled through the thickest part. This was the wheel of 1879 and 1880. The angle required a much greater depth than would seem needful at first sight, to keep the rubber tire from "stretching off" and leaving the rim in places, or altogether. Then came the crescent-shaped rim used by the "Columbia" and Jeffery in 1880, shown in Fig. 41, as modified by Jeffery in 1881, by taking away part of the stock in the thickest part of the crescent; this made the rim lighter, and saved depth of drilling for the spoke holes, the first construction almost invariably excluding the familiar nipple, which will be fully described in its place, with the tools used for its production. The cut made by Jeffery in the middle of the hollow of the crescent rim in 1881, as shown in Fig. 41, also gave room for the spoke head and its washer. This washer is a necessity, and has always been a stumbling

Fig. 40

Fig. 41

Fig. 42

Fig. 43

Fig. 44

Fig. 45

made of a separate strip closed and soldered into the inner part as clearly shown in Fig. 43, after the nipples and washers were put in place.

Also in 1884 Thos. Warwick, of Birmingham, England, brought out still another form of the double arch metal rim shown in section in Fig. 44. The long lap of this rim was brazed, and very greatly added to the strength of the rim. Warwick was forced to drill the large washer hole *a* in the outer member of his rim, as it was all closed, and there was no other way to put the washer in its place; but by doubling the stock at the apex of the inner arch of the rim he evidently added greatly to the strength of his structure.

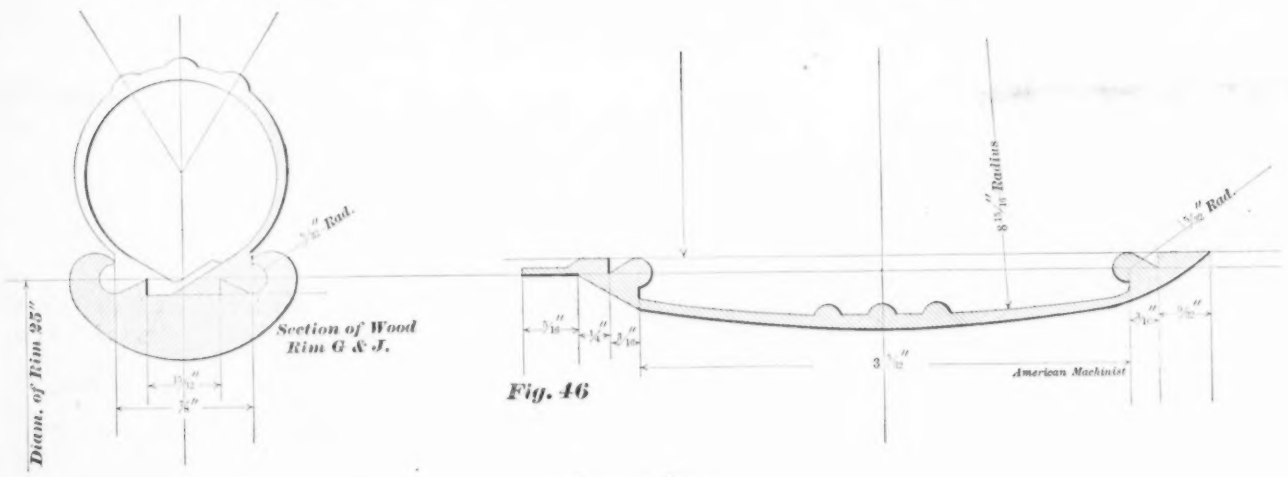


Fig. 46

BICYCLE TIRES.

block in the way of cycle wheel makers, both in metal and wood, and promises to be a very special feature of interest in connection with wood rims.

The nipple washer made a great deal of trouble in 1884, when the "Columbia" adopted the English rim shown in Fig. 42, which is made of a ring of round tube, one portion of which has its curve reversed to form the tire seat, while the remaining convex surface is compressed into a gothic arch form. This construction so far makes a very strong, stiff rim, but the nipple washer cannot be put in place without drilling a large hole through the concave member at *a*, Figs. 42, 44. This washer hole weakened this form of rim in a very objectionable manner, as the large washer hole and the smaller nipple hole came in the same radial line, and this removal of stock in both the outer and inner members of the structure at the exact load carrying point showed its weakness in practice. This Fig. 42 is also the rim with which Overman began in 1884. In 1884 also, Jeffery, or rather Gormully & Jeffery, devised nearly the same shape in a two-piece rim as shown in Fig. 43. In the 1884 rim, Fig. 43, Jeffery very ingeniously avoided the large hole for the washer by forming the rim of two separate pieces; the inner piece was of the same arch-shaped section as the "Columbia" and "Overman," and was drilled for the nipple, but the outer concave member which formed the seat for the tire was a protecting cover for the thin, soft rubber inner tube, which is at once strong, light and flexible, and the two generically differing forms of pneumatic tire are those which do employ this substantial outer covering in connection with a delicately elastic inner air tube, and those which consist of a single tube only, thickened or not in the places subject to most wear and greatest liability to accident. There may be another broad distinction made between those pneumatic tires which are cemented in place in the wheel rim, and those which are so held as to be removable by the use of the hand only when deflated, those of the later form being styled "detachable" tires.

The Gormully & Jeffery tire is of the double and detachable forms. That is, it consists of an inner air-holding tube of extremely thin and elastic rubber, protected by a strong and yet flexible outer cover, and this outer cover is so shaped as to hook under re-curved edges of the wheel rim, while inclosing the uninflated air tube, very readily, and by the use of the hand alone, while inflation of the inner tube locks the shoe into the hooking grooves of the tire so firmly that it cannot be moved by any stress to which a cycle wheel can possibly be subjected in use.

Fig. 45 shows the form of steel rim used by Gormully & Jeffery, and also gives sections of the elastic inner tube with its outer protecting shoe or cover, and gives a clear idea of how the inflation of the inner tube is made to lock the shoe tightly into the hooks of the steel rim; this section, and Fig. 46, the latter from a drawing of the G. & J. shoe and wood rim, are well worthy of study by machine designers as an example of desirable minor and secondary effects gained by the skillful use of essential primary conditions.

The problem was this: given a metal cycle wheel rim, a very thin circular tube to be blown up with a heavy air pressure, and an easily deflected fibrous cover for the air tube, how shall these three members be united in one structure without the use of other parts or any foreign substance in the nature of a cement, so as to be easily put together and taken apart without the use of skill or tools, and yet be so firmly held together as to be immovable on each other?

At first sight a sufficient solution of this problem seems impossible, yet it is perfectly met by hooking the sides of the trough, and making beads on the sides of the shoe to enter these hooks, and so arranging the parts that pressure in the inner elastic tube shall force the beads of the cover into the hooks of the tire. The whole problem is answered exactly in the same way that a connecting rod strap is secured to the rod butt; there is the double, hook-ended gib secured by the key, all circular and continuous, with the key instead of being a metal wedge exerting pressure by driving in two directions only, taking the form of a ring of compressed air, and exerting a holding pressure on the gib in all directions when the air pump, in place of the copper hammer of the engineman, drives the key home to hold all the three parts firmly together.

Mechanical analysis of this sort is very easy after the fact is accomplished, but it requires a very high order of ingenuity to attack a problem of this seemingly impossible sort and find a sure, easy and good way to fill all of its inexorable conditions, and the few simple details of section of the G. & J. air tube, shoe and wood rim, shown in Fig. 46, are among the most noteworthy efforts of inventive ability which have made the bicycle the miracle of construction which it is to-day. The section of wood rim and shoe in Fig. 46 shows clearly how the effect of fluid pressure within the shoe must inevitably force a more intimate and unyielding union of the rim and shoe as that pressure is increased, and also shows how the shoe may be easily released from the rim when internal pressure is removed by letting the air out of the inner tube, which is not shown in this section.

To make the steel rim used in Fig. 45, Gormully & Jeffery use a bright sheet steel strip, cut to exact width and shipped in large coils, from Morris & Bailey, and the Singer Nimick Company, Pittsburg. These coils are cut into rim lengths with a foot shear, and are then put through a first set of rolls which make the first bends of the edge hem, a second set of rolls which complete the hem, and a third set of rolls which form the main body of the groove, partly by rolling and partly by drawing, leaving the rim at the third rolling in the form of a trough section ring with hemmed edges, the hems being turned inward. In this form the rim goes to the joint filer, who scarfs the two ends, making a lap of about half an inch; they are then punched for a single brazing rivet, and go to the vise hand, who inserts the joint rivet and makes the rim ready for brazing. After brazing, which will be described here instead of under the general head of brazing, as rim brazing is quite a special operation, the rim goes to the fourth rolling machine, where it has the edge hooks formed and is given its final shape. All of these steps will be fully illustrated and described separately and in detail, as they are in all the cycle shops performed on special rolling machines, some of which are highly specialized and very interesting.

Fig. 47 shows the first, or edging-up rolls used by G. & J. for steel rims. This is a simple, solid housing pair of rolls frame, back geared and having a heavy fly wheel on a cross shaft journaled on the rear of the housings, and carrying a pinion which drives the large spur gear at the left, keyed to the lower roll shaft. The upper roll is driven by a pinion on the right-hand end of the lower roll shaft, meshing with an equal pinion on its own shaft; the gears are all covered, which is essential, as the thin stock used would very readily run into the gear teeth and cause a breakage. The housings are solid, without roll-adjusting screws. The roll adjustment is had through two cams solid on an overhead rock shaft, journaled in the housings, and having a cam toe at each end, directly under the journals, resting on top of the top roll boxes. The two cam toes which are solid with the rock shaft are finished exactly alike, with the rock shaft on the planer centers; the rock shaft is fitted with a forward reaching arm, which is forked at the front end, and carries a journaled block, this block being bored to take a long screw tapped into the cross member of the frame in front. The head of this bolt is on top of the swivel block carried by the rocker arm, and there is also a jam nut under the swivel block; by these means an equal and very reliable adjustment of the two ends of the top roll is secured. The bend made by the rolls of this first machine, and the rolls themselves, will be shown in a subsequent illustration.

HUGH DOLNAR.

The History of the Lathe.

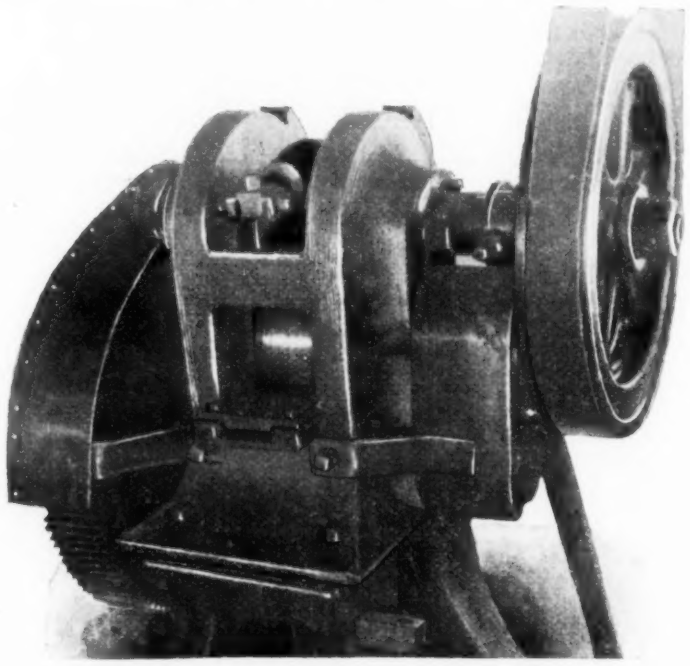
It does not seem to have been noticed that a most important centenary, from an engineer's point of view, has been allowed to pass by without remark. We allude to that of the invention of the slide rest by Maudslay in 1794, an invention which it is safe to say is one of the most important and epoch-

marking steps in the world's industrial history.

Practically, all we know on the subject is to be found in Nasmyth's "Essay on Tools," in the third edition of Buchanan's "Millwork," which appeared in 1841. This contains a drawing supplied by Francis, one of the sons of Joseph Bramah, headed "Bramah's original slide tool, 1794." It should be explained that Maudslay was in Bramah's employ at that time. As might have been expected, the appliance shown in the drawing differs a good deal in appearance from the slide rests now in use, being composed of somewhat slender-looking superposed frames, which do not seem adapted for heavy cuts. This rest was stated to be in use at the date of the drawing. It would be interesting to know the subsequent fate of this important relic, which should have found its way into our national collection, which again should be in some place more readily accessible to engineers than is South Kensington.

The invention was not patented, and it has been suggested that Maudslay derived the idea from the construction of some boring-mills, imported from Holland, at the Royal Arsenal, Woolwich, where he had served as a youth, and with which it is considered he must have been acquainted. However this may be, there can be no doubt of the importance of Maudslay's invention and of his having been the man for the hour, although, indeed, the slide principle did not at first spread so rapidly as might have been expected.

A forerunner of the slide rest in the form of a guide for a hand-turning tool is, as is



Rolls for Bicycle Rims.—Fig. 47.

pointed out by Herr Fischer in a recent number of the *Zeitschrift des Vereines Deutscher Ingenieure*, to be found in Hulot's memoir, "L'Art du Tourneur," in Vol. XXIII. of *Description des Arts et Metier*, 1775, in which, at page 375, we read: "Barre de Tour d'une nouvelle invention servant pour turner facilement des ouvrages parfaitment cylindriques." A guide bar of rectangular section fixed parallel to the axis of the lathe carries a slide adapted to be moved to and fro along its upper surface, and engaging by means of two projecting tongues with channels formed in the vertical side of the bar. Across the top of the slide is a groove for the tool, which is held down by a spring, and has an adjustable stop clamped on at the required point to limit its motion towards the work. The tool is to be moved to and fro by hand. This appears to have been the first application of the guide principle to the tools of turning lathes. Maudslay went considerably beyond this, in producing a compound slide and in giving motion to the parts thereof by means of screws, operated at first by hand, and afterwards automatically. The first account Herr Fischer has been able to discover of a self-acting slide rest is in one of the 1823 volumes of the *Jahrbuch des Wiener Polytechnischen Institute*. This contains a drawing clearly showing a slide rest, operated by a leading screw geared to the mandrel. Maudslay had, however, some years before this arranged his slide rest for a self-acting motion, as appears from a plate dated 1815 in Dr. Rees' "Cyclopædia," in which is shown gearing for connecting the screw of the lower slide to the mandrel; change gearing with fixed centers, as well as the slotted radial arm or "banjo plate" arrangement, is described and shown for cutting screws differing in pitch to the screw of the slide.

The lathe by Clement, described in the "Transactions" of the Society of Arts in 1828, shows some marked developments. It is a brake lathe with a rudimentary form of back gear, overhead countershaft and automatic variation of the speed of the mandrel for surfacing, by means of a pair of oppositely arranged conical rollers along which a driving belt is traversed; a self-acting movement can be imparted to the screw of the lower slide; the bed and slide faces are flat.

Fox, of Derby, about 1830, was using a rack and pinion arrangement for traversing the slide. In the German periodical referred to above attention is directed to full descriptions and drawings of lathes made by Fox for the Konigliche Gewerbinstitute at Berlin, which are to be found in the *Verhandlungen des Vereins zur Beforderung des Gewerbfleisses* for 1831 and 1832. The reference may be of value to the future historian of the subject. One of these lathes, a face lathe, has the mandrel driven by a long train of gearing, any one of the shafts of which may carry the driving pulley. An endless chain working under the bed, and driven from the mandrel by spur and worm gear, is used for traversing the slide in the screw-cutting lathe described as having been in use by Gallimores, of Sheffield, in "Manufactures in Metal," 1833. Two of the spur wheels were to be changed to vary the pitch of the screw cut, the mandrel is driven from a spindle at right angles to it carrying a stepped pulley and a bevel wheel adapted to engage either of the bevel wheels on the lathe spindle. Stepped pulleys grooved for catgut bands were in common use before that date.

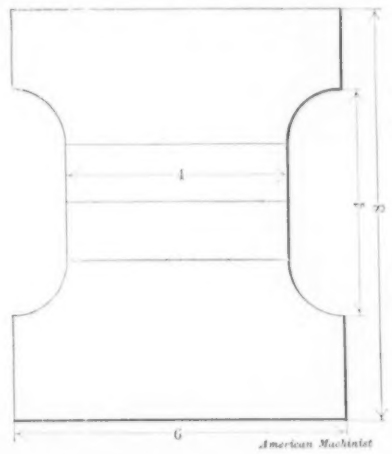
Whitworth's first patent, in 1835, has the slide rest traversed by a leading screw fixed in the bed. It has back gear, open and crossed belt reversing gear, overhead countershaft and change gearing with the "banjo plate."

The history of the steam engine as a locomotive, and for stationary and marine purposes, has been pretty fully dealt with in text-books, and by correspondence and otherwise in the columns of the engineering press, but considering their immense importance, and the pre-eminent position that English engineers have taken up in their origination and development, it is very remarkable how little has been done with reference to the history of lathes and other machine tools. There must be among our readers many whose minds are stored with valuable and interesting reminiscences on this subject, which if made public would form most important material for the history of the subject.—*The Engineer* (London).

Tests of Leather Belting.

By Prof. Chas. H. Benjamin.

Having noticed the article by Professor Flint, in the American Machinist for September 5th, on "A Study of Belt Lac-



ings," it occurred to me that the readers of this paper might be interested in the results of some experiments recently made on the strength and elasticity of the belts themselves. These experiments were made by Mr. E. A. Drake, in the testing laboratory of the Case School of Applied Science, under the direction of the writer.

The object of the experiments was to determine the ultimate tensile strength and percentage of elongation of the best quality of oak-tanned leather belting as made by different manufacturers, and to observe the relative strength of single and double belts of the same make.

In order to obtain fair samples the belting was all bought through outside parties in the ordinary course of trade, and the prices and discounts were practically the same for each series.

ers containing the jaws were so pivoted in the testing machine as to insure an even pull on the two edges of the belt.

The loads were applied gradually and the elongation measured at each 500 pounds increase of load. The per cent. of elongation in two inches of length for a total load of 2,000 pounds on 500 pounds per inch of width has been placed in the tables.

The average thickness of the single belts was about 0.20 inch, and of the double belts about 0.35 inch.

TABLE I.

Series No.	Single or Double.	Number of Samples.	Load in Pounds per Square Inch.	Load per Inch of Width.	Per Cent. Elongation.
1	Single.	13	4,770	905	9.88
1	Double.	15	3,525	1 560	6.60
2	Single.	15	5,107	1,008	7.20
2	Double.	15	4,605	1,415	4.80
3	Single.	14	3,730	841	10.18
3	Double.	15	4.173	1,414	5.96
Average	Single.	..	4,536	918	9.09
Average	Double.	..	4,101	1,396	5.79

The average ultimate strength per inch of width for single belts, as shown by the tests, 918 pounds, is considerably larger than the value usually assigned, while the ratio of the strength of double to single belting is $\frac{1,396}{918}$, or about $\frac{10}{6.58}$, the ratio generally used being $\frac{10}{7}$. It must be remembered, however, that the belting used in the experiments was all of the first quality, so that the average strength of belting sold in the market would be less than those given above.

One of the facts most noticeable in the experiments was the greater uniformity of double belting in strength and in elasticity, due, no doubt, to the fact that it is composed of two layers whose irregularities tend to neutralize each other. The single belts in nearly every instance showed a tendency to stretch more on one edge than on the other, and broke by tearing on the weaker edge, showing that edge to have been nearer the

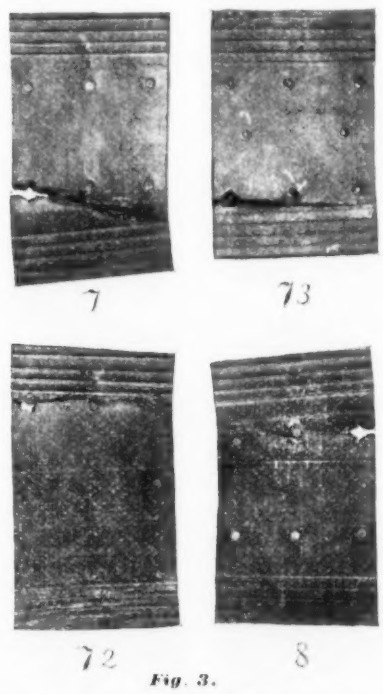


Fig. 3.

Fig. 2.

The samples obtained were the product of three of the leading belting factories of this section, and I will simply denominate them as Series 1, 2 and 3. Each series contained ten linear feet of single belting, and the same length of double belting, all being six inches wide.

The belts were cut into eight-inch lengths, making 15 test pieces of each kind, and the specimens were then trimmed to the shape shown in Fig. 1 to insure breaking outside the jaws.

Parallel lines one inch apart were ruled across the test specimen by which to measure the elongation from time to time. The specimens were gripped at each end by corrugated interlocking jaws, and the hold-

flank of the hide in the cutting. See Fig. 2, No. 41.

In the double belting this was less noticeable.

The strength per square inch of cross-section, as shown by Table I., is somewhat less for double belts than for single.

In every case the strongest samples showed the smallest percentage of elongation.

The experiments showed conclusively the disadvantage of using rivets in making double belts. The double belts in Series Nos. 1 and 3 had rivets at intervals, while those in Series No. 2 were simply cemented.

In nearly every case where rivets were present the fracture commenced at a rivet hole. See Fig. 2, Nos. 79, 80 and 83.

Several experiments were made on joints in single belts, and the results are given in Table II. The only cemented joint tried, that of No. 44, shows a greater strength per inch of width than any of the riveted joints.

The riveted joints (see Fig. 3) show an average strength per inch of width of 622 pounds, or about two-thirds the average of the strength of the single belts tested, while the cemented joint broke at 1,112 pounds per inch of width being a little stronger than the average of the belt samples in that series.

TABLE II.
BELT JOINTS.

Sample No.	Length of Lap.	Number of Rivets.	Total Breaking Load.	Load per Square Inch. Cross-section.	Load per Inch of Width.	Per Cent. of Elongation.
	Ins.					
7	5	6	4,170	3,940	709	7.5
8	4.6	6	3,610	3,600	611	7.5
72	7.2	9	4,520	3,545	762	5.5
73	5.1	8	2 420	1,792	406.8	7.5
44	Cemented.		4,380	5,560	1,112	7

As may be seen from Fig. 3, the riveted joints always failed at rivet holes.

The principal conclusions to be drawn from these experiments are: 1st, that double belts are superior to single in respect of their greater uniformity and less liability to become crooked by reason of uneven stretching, and 2d, that a belt can be made stronger without the use of rivets, either at joints or elsewhere, if good cement is used, and a proper degree of pressure is applied. Doubtless in situations where a belt is much exposed to dampness, rivets might be necessary at the edges of the splices to prevent starting up.

In case ordinary double belts are too heavy or too stiff for the required service, a light double belt may be obtained which will be no heavier than a single, and much more uniform.

Several experiments were also made on some single belting of the same quality as Series No. 1 to determine the transmitting power. A 4-inch single belt running on 24-inch pulleys at an average speed of 868 feet per minute, developed in four trials an average of 8 horse-power with a slip of only 5 feet per minute.

The tension on the tight side was 88 pounds per inch of width, and on the slack side only 22 pounds, the coefficient of friction averaging about .40.

The number of square feet of belt per horse-power per minute was only 44.

The horse-power developed is nearly double that generally allowed for 4-inch belts at such a speed, but if the belt were endless, cemented without rivets, the factor of safety would be about 10. I am inclined to believe that many of our belt formulæ are based rather on the strength of poor joints than of good leather.

Society of Naval Architects and Marine Engineers.

The third general meeting of the Society of Naval Architects and Marine Engineers was held on the 7th and 8th inst., in the auditorium at the house of the American Society of Mechanical Engineers, No. 12 West Thirty-first street, New York. The attendance was good, and great interest was taken in the reading of professional papers. Many men prominent in naval affairs took part in the discussions.

The following papers were read:

"American Maritime Development." By Capt. Henry C. Taylor, U. S. N., President Naval War College.

"Performance of the Twin-Screw Steamer 'City of Lowell.'" By Prof. Jas. E. Denton, Stevens Institute of Technology.

"Rudder Experiments—U. S. S. 'Monterey.'" By Elliot Snow, Assistant Naval Constructor, U. S. Navy.

"Aluminum—Its Alloys and Their Use in Ship Construction." By J. C. McGuire, Esq., C. E.

"Methods and Forms for Certain Ship Calculations." By D. W. Taylor, Naval Constructor, U. S. Navy.

"The Number of Longitudinal Intervals in Ship Computation, as Affecting the Accuracy of Integration for Displacement, and Note on the Relation Between Reduced and True Wetted Surface." By Prof. W. F. Durand, Cornell University.

"Recent Designs of Vessels for the U. S. Navy." By Philip Hichborn, Chief Constructor, U. S. Navy.

"Tactical Considerations Involved in Warship Design." By Albert P. Niblack, Lieutenant, U. S. Navy.

"The Centerboard—Its Influence on Design, Its Value and Its Proper Use." By Wm. P. Stephens, Esq.

"Engineering Research in the Navy." By Prof. Wm. S. Aldrich, University of West Virginia.

"The Ventilation of Ships." By F. B. Dowst, Esq., M. E.

"An Experimental Test of the Armored Side of U. S. S. 'Iowa.'" By Albert W. Stahl, Naval Constructor, U. S. Navy.

In another issue we shall give a more extended notice of some of these papers.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9" × 12", 6" × 9" and 4½" × 6". We recommend the 6" × 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

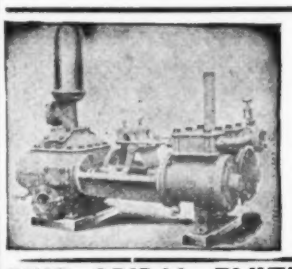
The Appleton Mfg. Co., Philadelphia, Pa., have issued a small catalog, which they designate as "Catalog No. 5," illustrating and describing their various lines of grinding machinery.

The Frick Co., of Waynesboro, Pa., send us a finely gotten-up catalog fully illustrating and describing their Corliss engines. It is replete with information of general interest and value, and is standard size, 6"x9".

We have received from the Case School of Applied Science, Cleveland, Ohio, an elegant pamphlet, setting forth the attractions and advantages of this school, which we believe is doing an important educational work in technical lines.

The Cumberland Iron and Steel Shafting Co., Cumberland, Md., have issued "Price List B," which gives the latest quotations and information regarding their lines of manufacture, which is shafting and other power transmission apparatus.

Henry R. Worthington, Brooklyn, N. Y., sends us an illustrated catalog, which is a special edition for use at the Atlanta Exposition. It contains much interesting information regarding pumping machines generally, and is sent to those interested on application. It is 5¼"x6⅝".



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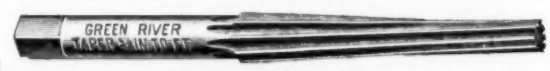

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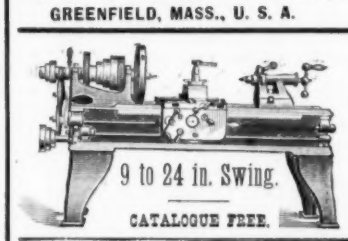

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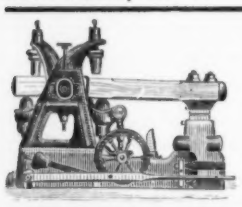

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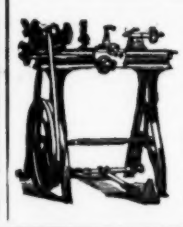

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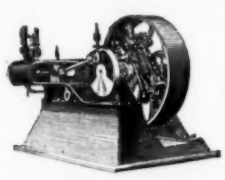

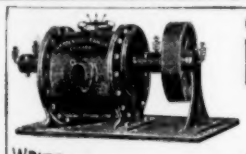

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We have received from Gowing & Co., 95 Milk street, Boston, Mass., a pamphlet illustrating and describing the Barrus Universal steam calorimeter of the "1895 pattern." Those who are interested in the determination of the quality of steam will be interested in this pamphlet, which we understand is sent to those interested on application.

The Seneca Falls Mfg. Co., Seneca Falls, N. Y., send us Catalogs No. 15A and No. 15B, which are devoted, the first to foot and hand-power woodworking machinery and the last named to foot and power lathes and accessories. They contain interesting information regarding such machinery, and are sent to those interested on application. They are 7"x9".

The Jeffrey Mfg. Co., Columbus, Ohio, send us an illustrated catalog and price list of machinery for handling and conveying coal and other materials. The catalog is quite full and complete, and gives much valuable information regarding methods of conveying materials within manufacturing establishments or in mines, and in engineering work generally. It is 5"x7½".

Grant Sipp, Paterson, N. J., sends us a collection of circulars in which are illustrated and described various forms of small engines and boilers made by him. There are both vertical and horizontal engines with small cylinders about 1 inch to 2 inches diameter, and he furnishes the engines either in the form of rough castings, or partly finished, or complete ready to run.

C. M. Giddings, M. E., Rockford, Ill., makes up a catalog of blue prints, which are apparently made from photographic reproductions of his drawings of Corliss and other engines, which he supplies to the trade, to schools, or to anyone wanting them. The catalog gives an excellent idea of the appearance of the completed engines, and includes also specimen sheets of the general and detailed drawings. It is 11¼"x8".

Albert L. Colburn, New Haven, Conn., sends us Catalog "No. 5," which is devoted to the illustration and description of portable drilling and tapping machines, universal swing frames, grinding machines, etc. These machines are more or less familiar to the readers of the AMERICAN MACHINIST, and the catalog gives full information regarding them. The catalog is 4⅝"x5¾", and apparently could as well have been standard size, 4½"x6".

The Lidgerwood Mfg. Co., 96 Liberty street, New York, have issued a finely illustrated and attractive catalog showing their machinery and apparatus for excavating and conveying materials in engineering work, such as dredging and digging canals, building railroads, etc. The catalog will be found an interesting and valuable one to those engaged in such work, and is sent to interested parties upon application. It is 9⅜"x5⅞", and evidently could as well have been standard size.

The Jeffrey Mfg. Co., Columbus, Ohio, issue a catalog which illustrates and describes their elevating, conveying and power transmission machinery, which is intended for use in warehouses and manufacturing establishments where materials or articles of manufacture completed or in process of manufacture are to be moved, and by the use of which power is utilized for this purpose. The catalog will be found a valuable one to those who are interested in this kind of work; it is 5"x7⅝".

The Billings & Spencer Co., of Hartford, Conn., have issued a special catalog illustrating and describing their line of manufacture especially for electrical railways. This includes hangers of various forms, yokes, strain insulators, car house hangers, drop forged steel mechanical clips, trolley wire solder ears, trolley stands, noiseless ratchet brakes, and in fact all that line of smaller parts of trolley lines which are often made of cast-iron and in a very inferior manner, but are made by this company of various materials drop forged, and in the best possible manner, the goods being intended for first-class construction. A new insulating material, called "colophite," is used. The catalog is an uncommonly fine one, and is 12⅝"x 9¼"; it can readily be trimmed, however, to standard size, 9"x12".

MANUFACTURES

The Labelle Mfg. Co. has recently been organized at Holyoke, Mass.

The Allen & Cram Machine Co., of Raleigh, N. C., has been formed with $10,000 capital stock.

The North State Lumber Co. has been organized by G. J. Cherry and others at Parmele, N. C., with $25,000 capital stock.

It is rumored that Isaac Hoffman's Silver Lake Paper-mill, of Gibsonville, N. Y., will be converted into a bicycle factory.

The paper-mill of Moyer & Pratt's, of Greig, N. Y., which was recently destroyed by fire, will be rebuilt next season.

The Berliner Gramophone Co., of Koanok, Va., has been formed with a capital stock of $50,000. Thos. L. Latta is president.

The Co-operative Cotton Mills Co. has been formed to erect a knitting-mill, with $12,500 capital. A. H. George is president.

At Philadelphia, Pa., the Penn Bicycle Co. has been formed, with $10,000 capital, by Harry D. Lecate and Edwin C. Howard.

The Hollinger (Ala.) Mfg. Co. will construct a dam to cost $10,000 to produce water power for operating a large new flour-mill.

The Hunter Automatic Co., of Huntington, W. Va., has been organized by L. J. Hunter, and others, with a capital of $200,000.

The Pope Mining Co., of Du Quoin, Ill., has recently been incorporated by B. F. Pope, Jr., P. D. Niffin, John D. Buchan and B. W. Pope.

The Ingledew-Henderson Mfg. Co., of Chicago, Ill., has been organized by Lumley Ingledew and Henry A. Leland, with a capital of $12,000.

The Moomaw Car Coupler Co., of Salem, Va., has been organized with P. L. Stearns as president and treasurer, and H. C. Moomaw as vice-president.

The Elmore Drill Co., of Dubuque, Iowa, has been incorporated by W. J. Young, Jr., H. P. Dickinson and E. W. Grievish, with a capital of $100,000.

At Baltimore, Md., a $100,000 company has been organized to manufacture a new steam engine, invented by Jas. P. Gray, who is to be the superintendent.

The North Carolina Fence Co., of Greensboro, N. C., has been organized, with a capital of $45,000. Geo. Burnham, Jr., is president and W. H. Pearce, manager.

The Texas Co-operative Manufacturing Co., of Waco, Texas, has been incorporated by J. W. Riggins, S. W. Slayden and others, with a capital stock of $150,000.

The Miller Gas Engine Company, of Springfield, Ohio, has been organized, with a capital of $50,000, by James D. Hurd, Samuel McGrew, John L. Zimmerman and Ed. Hurd.

The Marshall Bicycle Pump Co., of New York City, has been organized to manufacture bicycle pump and bicycle attachments, with a capital of $6,000, by C. B. Boynton, E. W. Dickinson and A. B. Marshall.

The Kidd Bros. and Berger Steel Wire Company, of McKees Rocks, Pa., has been incorporated with a capital stock of $25,000. The incorporators are Rutherford Berger, W. S. Kidd, J. C. Berger, Wm. Kidd and H. H. Kidd.

The Logan County Electric Light Co. has been organized at Lincoln, Ill., with a capital of $10,000, by John W. Lutz, Chas. C. Reed, John S. Gerny, T. A. Reynolds, Adam Denger, D. H. Harts, H. H. Gains and John A. Lutz.

The St. Louis (Mo.) Manufacturing Association has been organized and have elected the following officers: L. D. Kingsland, president; E. O. Standard, J. G. Butler, L. D. Dozier, T. A. Meysenburg and W. F. Nolker, vice-presidents, and George W. Brown, treasurer.

The Ashland Mfg. Co., of Ashland, Ohio, is a newly organized company engaging in the manufacture of pumps. They have ordered from the Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, lathes, planers, drills, and other tools suitable for their manufacture.

Some time ago we published an item to the effect that the Yale & Towne Mfg. Co., Stamford, Conn., would engage in the manufacture of a high grade bicycle. The company now deny this, and say that their present products fully engage their attention, and that the report never had any foundation, in fact.

The export trade of the Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, continues to increase, and during the last ten days they have shipped eight machines to England, two to Russia, three to South America, and two car loads to one party in Chihuahua, Mexico. They have also delivered to the New York Navy Yards three heavy machines to be used in manufacturing guns and other ordnance.

The Berlin Iron Bridge Co., of East Berlin, Conn., have just completed for Jas. McLaren, of Brooklyn, N. Y., a new iron building to cover his stone yard. The yard is 70 feet in width and 120 feet in length, and the building covers the entire yard, and is arranged to carry a traveling crane of 15 tons capacity so that stone can be moved to any

The Elliott Drill Press
FOR ANY LIGHT WORK.
LARGE RANGE OF WORK—LOW PRICE.

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A. J. WILKINSON & CO.,
180 to 188 WASHINGTON ST., BOSTON, MASS.
SEND FOR CATALOGUE.

RECEIVER'S SALE.

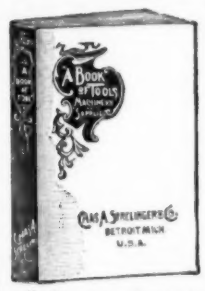
The remaining assets of the Electric Mfg. & Gas Engine Co., Greenbush, N. Y., will be sold at auction at the office and residence of the undersigned, on **November 20th** at noon, including stock of finished and unfinished

ROLLASON GAS ENGINES,

and parts, patterns, patents, special tools, book accounts, judgments, etc.

Inventory can be seen and full particulars may be obtained, on application to the Receiver or his attorney, Elisha K. Camp, 265 Broadway, New York City.

JAMES H. PRATT,
RECEIVER,
Greenbush Heights, New York.



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"Having had considerable experience in getting out Tool catalogues, let us say to you that the best and finest catalogue we have seen up to to-day, is 'A Book of Tools.'

MONTGOMERY & CO.,
New York."

It is very clever in Montgomery & Co., to pay us this handsome compliment, but then they're clever people, and the Book of Tools is a clever catalogue. It contains 550 pages, over 2,000 illustrations, and is the most comprehensive work of its kind ever issued. It is invaluable to the buyer and user of tools, and will be sent post-paid to any address upon receipt of 25 cents in stamps.

CHAS. A. STRELINGER & CO.
DETROIT, MICH.

LATHES
AND OTHER METAL WORKING TOOLS.
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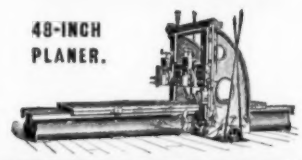
FITCHBURG MACHINE WORKS,
FITCHBURG, MASS.



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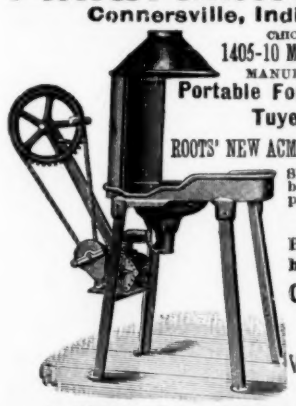
ROOTS' NEW ACME HAND BLOWERS,
Blow speeded, Force blast, Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, Etc.
COOKE & CO.
Selling Agents,
163 and 165 Washington St.,
NEW YORK.



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Comprising full and complete answers to 300 questions for the use of engineers and firemen, when preparing to make application for examination for U. S. government and State license; and for the information of engine builders, boiler makers, machinists, etc.
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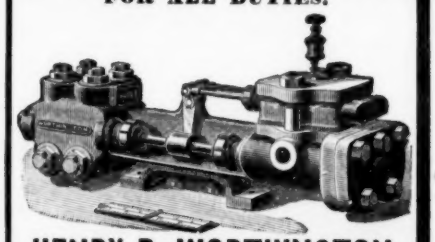
WORTHINGTON STEAM PUMPS
FOR ALL DUTIES.



HENRY R. WORTHINGTON,
NEW YORK, 86 and 88 Liberty St. BOSTON, 70 Kilby St. PHILADELPHIA, 724 Arch St. CLEVELAND, 24 South Water St. CHICAGO, 185 to 189 Van Buren St. ST. LOUIS, Eighth and St. Charles Sts. INDIANAPOLIS, 64 South Pennsylvania St. DETROIT, 155 Jefferson Ave.

part of the yard by power, making it one of the most complete stone cutting yards in this vicinity.

The Newburgh Ice Machine and Engine Co. has been organized at Newburgh, N. Y., and have purchased the plant formerly operated by the Whitehill Engine and Pictet Ice Machine Co. The officers of the company are: Edgar Penney, formerly of the Frick Co., of Waynesboro, Pa., president; Frank Adams Acer, vice president, and Robt Whitehill, secretary and treasurer. They will manufacture the Corliss steam engines, general machinery, iron and brass castings, pattern work, etc.

The Skinner Chuck Co., of New Britain, Conn., have gone into the manufacture of a chuck designed especially for bicycle manufacturers and for use on screw machines generally. It is a form of chuck which has been made in most shops where screw machines are used to any great extent, but has not, we believe, previously been made a regular article of manufacture. It is very simple in construction, consisting of a cylindrical body with a transverse rectangular slot containing two jaws, one of which rests upon two screws, permitting it to be adjusted, while the other jaw can be tightened by a screw and key wrench.

Machinists' Supplies and Iron.

NEW YORK, November 9, 1895.

Iron—American Pig—We quote standard Northern brands, $13.75 to $14.50 for No. 1; $12.75 to $13.50 for No. 2; $12.50 to $13 for No. 2 Plain, and $12.50 to $13 for Gray Forge. Southern brands, $14 for No. 1; $13.50 to $13.75 for No. 2; $13 to $13.50 for No. 3; $13.50 to $14 for No. 1 soft; $13 to $13.50 for No. 2 soft; and $12.50 to $12.75 for Foundry No. 4.

Antimony—The market is quiet. Cookson's is quoted at 7¾c. to 8c.; Hallett's at 7c. to 7⅛c., and Japanese at 6¾c.

Lard Oil—Prime City is quoted at 50c. to 51c.

Copper—The market is quiet, and the demand is light. Prices are somewhat uncertain, Lake Copper is offered at 11¾c., and probably can be purchased at a shade less. Casting Copper is held at 11c. to 11¼c.

Lead—The market is dull and weak, and prices are a little lower. Common Domestic has been secured at 3.30c. in single carload lots, and probably less will be accepted for larger lots. Bids of 3.25c. have been refused.

Spelter—The market is dull and prices are lower. For New York delivery, 3.85c. to 3.90c. is quoted for ordinary brands.

Tin—The market remains active at prices of 14.55c. to 14.60c. net cash for round lots.

Established in 1874.

CLEVELAND TWIST DRILL CO.

COR. LAKE & KIRTLAND STS. CLEVELAND, O.

99 Reade Street, New York.
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SECOND-HAND MACHINERY.

1 86 in. x 18 ft. Lincoln Triple-Geared Engine Lathe.
1 84 in. x 21 ft. Wilmarth " " " "
37 in. x 42 in. x 10 ft. Fifield Lathe, C. Rest and P. C. Feed.
34 in. x 47 in. x 16 ft. Pond Mach. Tool Co. Lathe, C. Rest and P. C. Feed. Has 24 in. Chuck.
32 in. x 8 ft. D. W. Pond Lathe, C. Rest and P. C. Feed.
29 in. x 10 ft. Perkins Lathe, P. Gib Rest and P. C. Feed. Has 17 in. Chuck.
26 in. x 17 ft. D. W. Pond Lathe, C. Rest and P. C. Feed.
26 in. x 22 ft. " " " " " " " Has 21 in. Chuck.
24 in. x 10 ft. Pratt & Whitney Lathe, C. Rest and P. C. Feed.
20 in. x 8 ft. Fifield Lathe, C. Rest and P. C. Feed.
20 in. x 11 ft. Wm. Sellers Lathe, C. Rest and P. C. Feed. Has 16 in. Chuck.
20 in. x 8 ft. Pratt & Whitney Lathe, C. Rest and P. C. Feed.
18 in. x 9 ft. " " " " " " "
16 in. x 10 ft. Bullard Lathe, Plain Gib Rest.
14 in. x 6 ft. S. Ashton Hand Lathe, Plain Gib Rest.
Lot Speed Lathes Assorted.
60 in. x 60 in. x 26 ft. L. W. Pond Planer.
38 in. x 38 in. x 10 ft. " " "
36 in. x 36 in. x 10 ft. D. W. Pond "
32 in. x 32 in. x 10 ft. " " " 2 Heads.
26 in. x 26 in. x 6 ft. Pond Mach. Tool Co. Planer.
15 in. x 15 in. x 16 in Whitcomb Crank Planer.
12 in. Stroke, Warren Traveling Head Crank Shaper.
15 in. " Hendy Friction Shaper.
Semi-Universal Warren Radial Drill, 48 in. Arm.
Full " Bickford " " 72 in. "
32 in. D. W. Pond Upright Drill, 8 Gears and Power Feed.
30 in. Prentice " " " " "
28 in. Barney " " " " "
No. 3 Brown & Sharpe Universal Milling Machine.
60 in. Pond Boring and Turning Mill, 2 Heads.
72 in. Newark Mach. Tool Co. Pulley Lathe, 2 Tools.
26 in. Stevens Pulley Lathe, 1 Tool.

700 Machine Tools in Stock. Send for Lists. Bicycle Catalog Just Out.

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SECOND-HAND MACHINERY.

36" Gould & Eberhardt Gear Cutter.
26" Pratt & Whitney Chucking Lathe.
60" Triple-geared New Haven Lathe, with chuck jaws.
40" New Haven Back-geared and Power-feed Drill.
32" Double-head Pond Planer.
No. 1 Giant Key Seater.
Send for complete list. Send for catalogue of Bicycle machinery.

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MACHINERY FOR SALE.

Lot of 6½" and 7⅛" Hammered Steel Shafting with Pillow Blocks and Couplings.
3 60 x 14 x 6½ Friction Clutch Pulleys.
2 60 x 14 x 7⅛ " " "
All good as new; will be sold at less than half value.

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Second-Hand Machinery.

LATHES.
2 10 in. x 5 ft. Foot & Power.
2 11 in. x 5 ft. Power only.
1 15 in. x 6 ft. Dustin.
1 16 in. x 8 ft. Flather.
2 18 in. x 8 ft. Flather & Prentice.
3 18 in. x 8 ft. Lodge & Davis.
2 21 in. x 10 ft. Pratt & Whitney.
1 27 in. x 10 ft Dustin.
1 28 in. x 12 ft. Blaisdell.
2 30 in. x 14 ft. Lincoln.
1 32 in. x 13 ft. Bement Triple Geared.
1 22 in. x 10 ft. Niles.
1 24 in. x 10 ft. Niles.
1 79 in. Driving Wheel, Bement.
1 48 in. x 18 ft. Gay & Silver.

PLANERS.
3 48 in. x 52 in. x 6 ft. Pond, two heads.
1 48 in. x 32 in. x 8 ft. Pond, two heads.
3 24 in. x 24 in. x 6 ft. W & L., one head.
3 28 in. x 28 in. x 8 ft. Gay & Silver.
1 32 in. x 32 in. x 10 ft. W. & L.
1 38 in. x 38 in. x 10 ft. Aldrich.
1 32 in. x 10 ft. Open Side.
1 60 in. x 60 in. x 22 ft. Hepworth.

DRILLS.
3 22 in. Back Geared.
2 25 in. " & P. F., Snyder.
1 34 in " " " Harris.
2 No. 1½ Niles Radial.
2 Suspension Drills.

MILLING MACHINES.
1 No. 1 B. & Sharpe.
2 No. 13 Garvin.
1 No. 15 "
1 No. 2 " Hand, and others.

SHAPERS.
9 in., 12 in., 13 in., 15 in., 20 in.

MISCELLANEOUS.
1 18 in. P. & W. Screw Machine.
1 20 in x 6 ft. Flather "
2 Horiz. B. & D. Machines.
1 Cylinder Borer, P. & A.
1 30 in. Motor Gear Lathe
1 Double Punch and Shear.
1 20 in. Pulley Lathe.
1 Hydraulic Riveter.
2 Bolt Cutters.
1 Nut Tapper.
1 20 in. Pattern Lathe.

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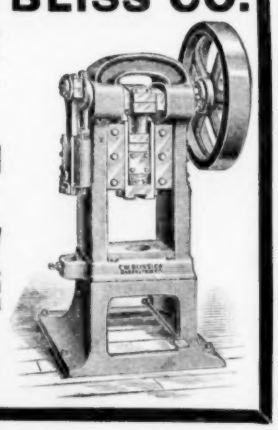

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ENGINE LATHES.
25 x 12, Fifield, Compound Rest.
15 x 6 Blaisdell, Compound Rest with turret.
13 x 6 Ames, Rise and Fall Rest.
11 x 4 Manu Lathe.
16 x 7 Maker Unknown.
16 x 8 Blaisdell, Plain Rest.
18 x 10 Flather, Plain Rest.
18 x 10 Blaisdell, Plain Rest.
28 x 20 Perkins Compound Rest.
37 x 14 Maker Unknown.

PLANERS.
16 in. x 16 in. x 4 ft. Hendey.
20 in. x 20 in. x 4 ft. Nashua.

SHAPERS.
10 in. Juengst, Crank.
12 in. Juengst, Crank.
10 in. Wood and Light, Traverse Head.
18 in. Putnam, Traverse Head.
15 in. Juengst Friction Shaper.

DRILL PRESSES.
10 in. No. 1 Slate's Sensitive.
6 Spindle Quint, Turret.
No. 2 Three-Spindle, Garvin.

DRILL PRESSES.
No. 2 Four-Spindle, Pratt & W.
No. 4 Four-Spindle, Garvin.
21 in. Kirkhoff, W. & L. B. G.
24 in. Blaisdell, Wheel Feed.
24 in. Aurora, Back Geared.
30 in. Pond, Back Geared, Power Feed.
9 ft. Holly Mfg. Co., Radial.

SCREW MACHINES.
No. 1 Garvin, Wire Feed.
No. 5 Brown & Sharpe.
No. 1 Garvin, Plain.
No. 2 Brown & Sharpe, Plain.
No. 2 Garvin, Wire Feed.
16 in. x 5 ft. Reed Turret Chucking Lathe.

MILLING MACHINES.
No. 2 Pratt & Whitney, Lincoln.
No. 2 Garvin, Plain.
No. 0 Garvin Universal.
No. 2 Garvin Duplex.
No. 2 Garvin Hand.
No. 4 Brainard Standard Universal.
Putnam-Lincoln.
No. 2 Pratt & Whitney, Lincoln.

Also, a large list of other machines. Write for complete list, detailed description and prices.

THE GARVIN MACHINE CO.,
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we offer our entire stock of machine tools at SECOND-HAND prices. This is a BONA-FIDE offer and the OPPORTUNITY of the YEAR.

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MACHINERY BARGAINS
BEFORE REMOVAL
At Phœnix Iron Works, Trenton, N. J.

15 in. x 6 ft. Engine Lathe.
22 " 12 " " "
29 " 13½ " " "
26 " 20 " " "
37 " 30 " " "
71 " 18 " " "
52 in. x 20 ft. Engine Lathe.
19-36 and 50 in. Drills.
Portable Drill.
36 in. x 14 ft. Planer.
12 in. Shaper Traverse Head.
Gear Cutter, 54 in.
Milling Machine.

10 ft.-16 ft. Vertical Boring and Turning Mill, Cranes, Blower, Boiler Rolls, Punch and Shear, etc.

Send for full list and prices.

GEORGE PLACE MACHINE CO.
145 Broadway and 86 Liberty St.,
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SECOND-HAND TOOLS.
MODERN STYLE. FIRST-CLASS ORDER.
Will Be Sold Very Low Before Removal.

ENGINE LATHE—Blaisdell, 13 in. x 6 ft.
" " Blaisdell, 16 x 6 ft., Raise and Fall Rest.
" " Pratt & Whitney, 16 x 7 ft., Raise and Fall Rest.
" " Putnam, 16 x 8 ft., Raise and Fall Rest.
" " Flather, 18 x 8 ft., Hollow Spindle, Cross Feed.
" " Pond, 20 in. x 15 ft., Extra Heavy, A 1.
" " Harrington, 20x20 ft., Compound Rest, Cross Feed
" " Fay & Scott, 36x18 ft., Compound Rest, Cross Feed.
" " Pratt & Whitney, 42 in., raising blocks to 48 in., Triple Geared, Compound Rest and Cross Feed, A 1 order.
" " Hewes & Phillips, 60 in. x 20 ft., Triple Geared, Compound Rest, etc. A 1.
" " Union, 72 x 20 ft., Triple Geared, Screw Feed.
PLANER—Pease, 22 x 5 ft., Heavy Pattern, Improved Style, A 1.
" Hendey, 22 x 5 ft., Improved Style, A 1.
" Gould & Eberhardt, 26 in. x 8 ft. A 1.
" Pond, 32 in. x 8 ft. Good order.
" Pond, 36 x 12 ft. A 1 order.
" Betts 36 x 10 ft., Extra Heavy.
" Gray, 48 x 12 ft., Spiral Geared, Improved A 1.
" Betts, 60 x 16 ft., 4 Heads, Extra Heavy, A 1.
" Crank 12 in. stroke. "Pond's."
SHAPER—Hewes & Phillips 10 in. Crank Motion.
" Gould & Eberhardt 15 in. Crank Motion.
" Prentiss 17 in. Crank. Good as new.
" Hendey 24 in. Friction. Good order
" Pratt & Whitney 14 in. x 60 in., Traveling Head, 2 Tables.
" Fitchburg 14 in. Traveling Head, 28 in. Feed
" Warren 14 in. stroke, Traveling Head. A 1 order.
DRILL—Prentice 26 in., Friction Pulleys for tapping.
" Blaisdell 28 in., Back Gears.
" Hamilton 28 in., Back Gears, Automatic Feed.
" Pond 32 in. Extra Heavy, Back Gears, Automatic Feed.
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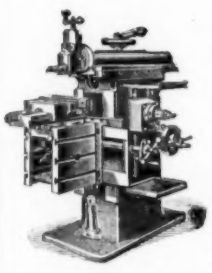

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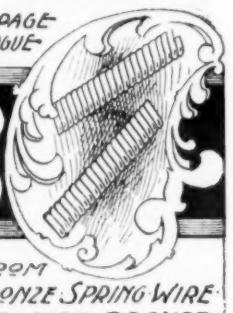

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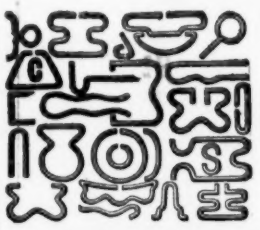

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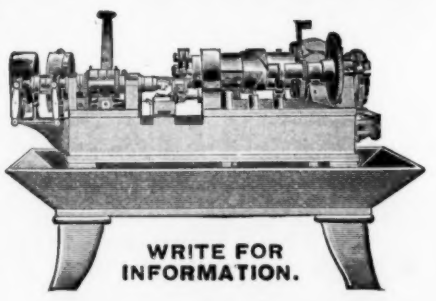

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"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

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Expert mech. draftsman, prac. mach. & pattern-maker, wishes position; New York or vicinity; extensive shop and office exp. Box 150, AM. MACH.

Situation by brass molder on floor or bench; good mixer; good letters; will go anywhere. Address Short, AMERICAN MACHINIST.

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Patternmaker, aged 23, wants position in Ohio or adjoining State; 4 years' experience in wood patternmaking. Box 152, AMERICAN MACHINIST.

Wanted—Pos. as salesman or assist. supt. by young man; 4 yrs. shop, 5 yrs. drawing-room experience; light and heavy mach'y. Business, AM. MACH.

Wanted—A traveling salesman to handle small machinists' tools, such as reamers and gages; state salary; none but experienced man with satisfactory reference need answer. Box 151, AM. MACH.

One who has had a varied experience in the design, construction and repairs of coal mining machinery, is open for engagement, on or after November 1, 1895. Box 156, AMERICAN MACHINIST.

Machinist and engineer familiar with best machine, boiler shop and foundry practice, wishes to make a change; competent to take entire charge of works or of engineering & estimat'g departments; capable manager & salesman. M., AM. MACHINIST.

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Position desired by man who has had fourteen years' experience as head draftsman and superintendent of machine shop and foundry; can control considerable trade for castings and tool work. A. E. M., care AMERICAN MACHINIST.

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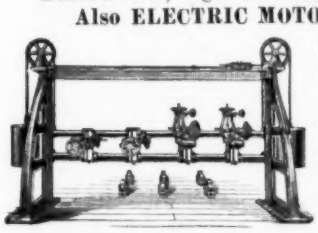

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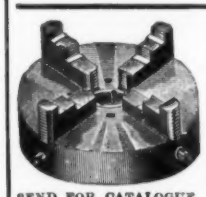

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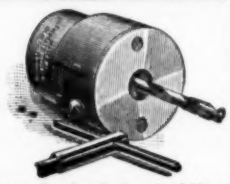

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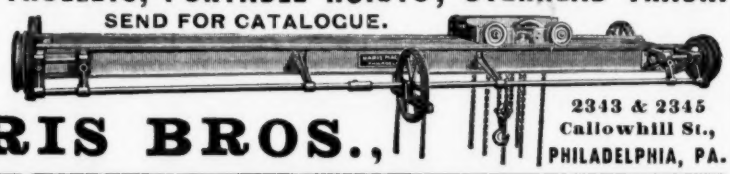

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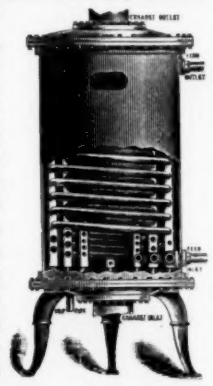

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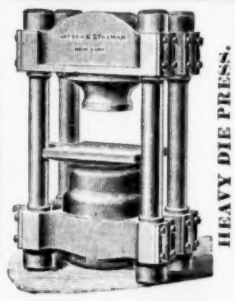

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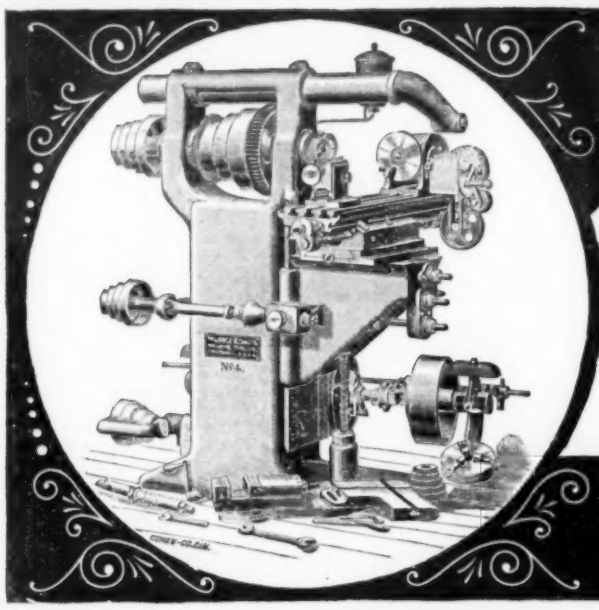

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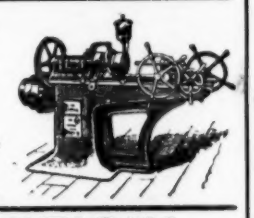

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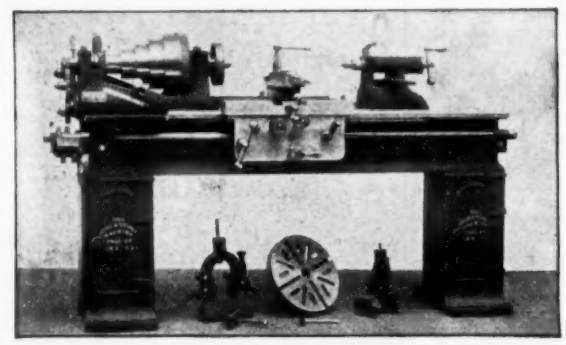

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60	inch by	60	inch by	12	feet.
48	" "	48	" "	12	"
36	" "	36	" "	8	"
24	" "	24	" "	6	"
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PATENT CUTTERS. SPECIAL MILLING MACHINES DESIGNED.

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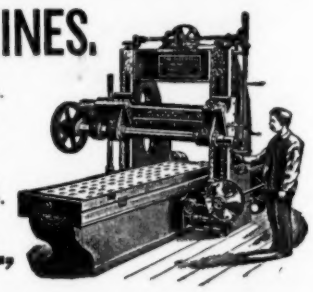

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ABOUTTHEMOSTDISAGREEABLEJOBAROUND AWOODWORKINGSHOPISTHEFILINGOFABAND SAW.THISSAWHASSIXTEENHUNDREDAND SIXTYSIXTEETH.WEHAVESOMEFINERAND SOMECOARSERLFORAGOODJOBIMUSTGIVE EACHTOOTHTHREEFILESTROKES.TOTALFOUR THOUSANDNINEHUNDREDANDNINETYEIGHT STROKES.IADMITIDONTLIKETHEJOB.ITGIVES MEAPAININTHENECK,HURTSMYEYES,SPOILS MYTEMPER.IDONTDOUTANYOFTENERTHANI CANHELPTHATSCERTAIN.

YOU'D READ IT IF YOU HAD—TO.

Well, it's just the same with filing a band saw by hand. No spaces between the teeth. Tiresome work. Put off as long as possible. They'd rather work with dull saws, producing less work and rougher work. Don't stick to the old barbarity! Away with it!! Get our Automatic Machine. It files 125 teeth a minute. Uses common files. More uniform work than can be done by hand. So easy to run it! Fun for a bright boy. Keep your saws sharp. Do the most work! smooth work! Don't fear unevenly spaced saws, very fine or very coarse saws. Our Machine Files Them.

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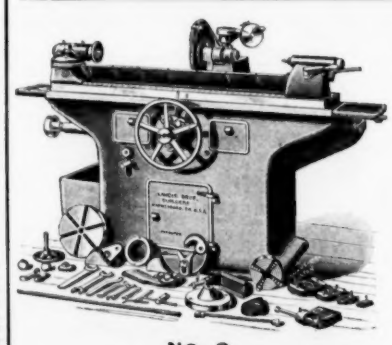

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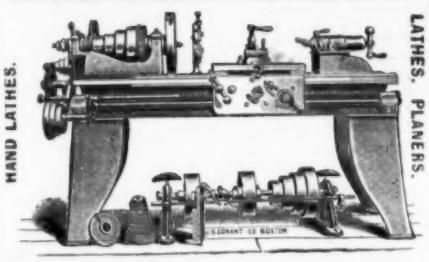

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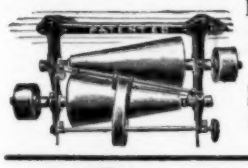

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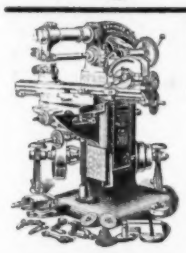

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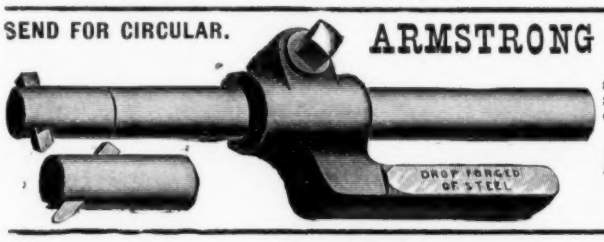

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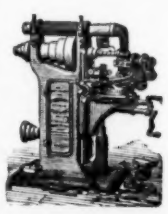

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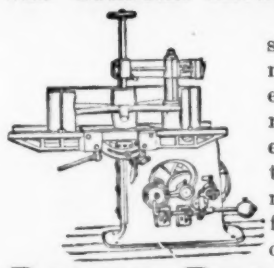

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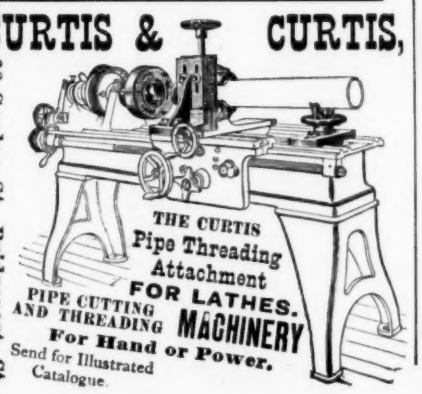

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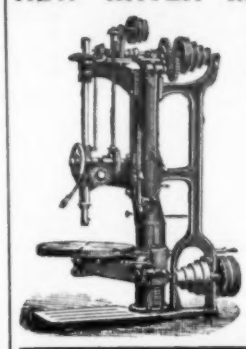

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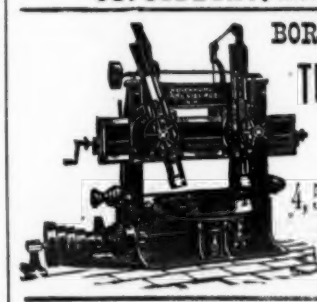

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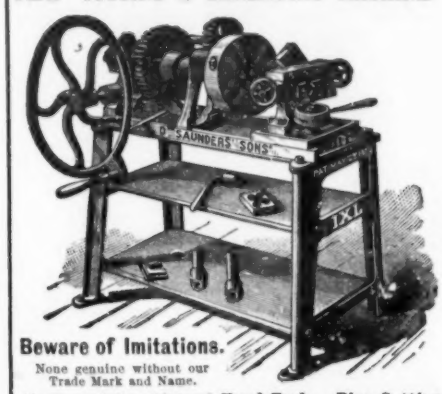

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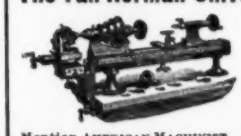

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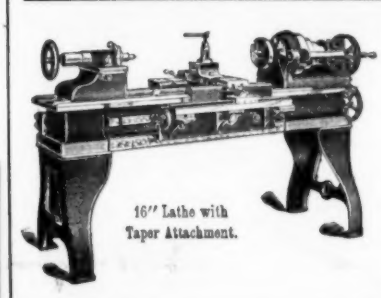

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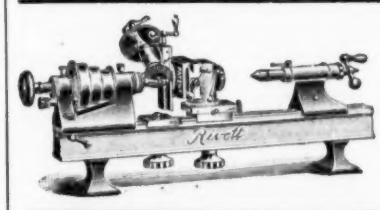

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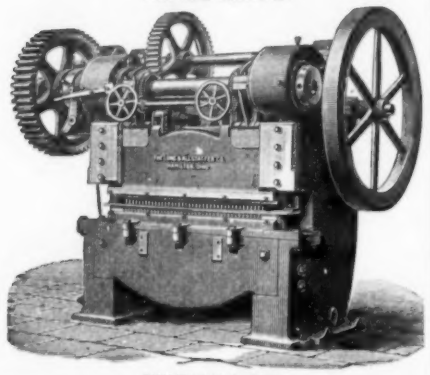

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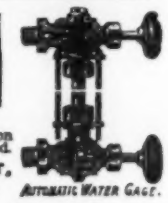

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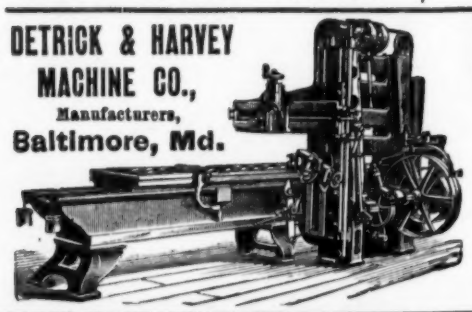

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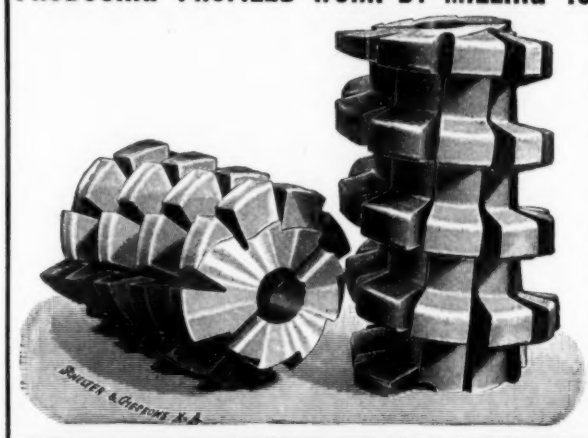

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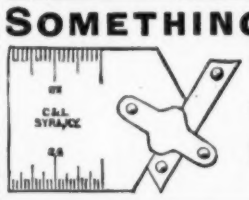

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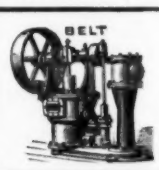

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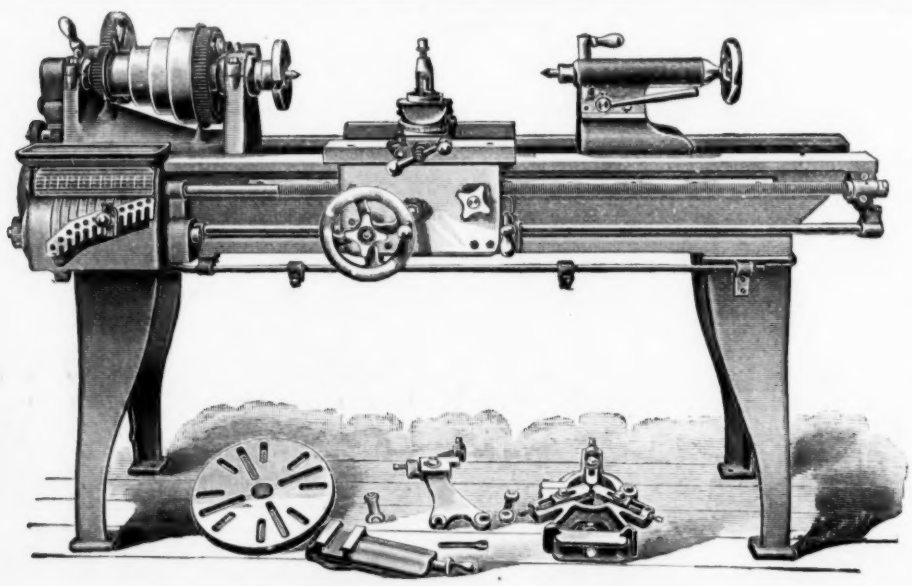

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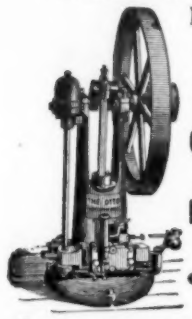

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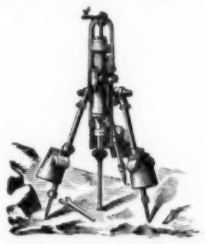

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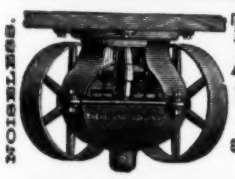

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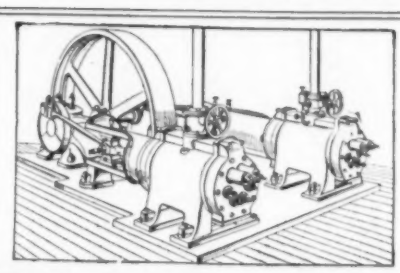

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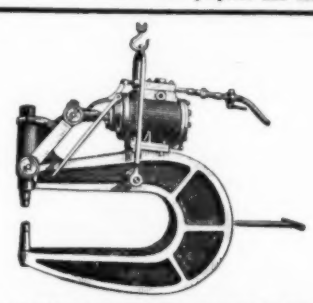

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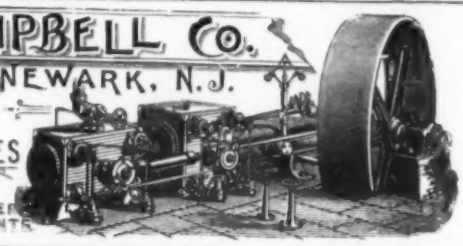

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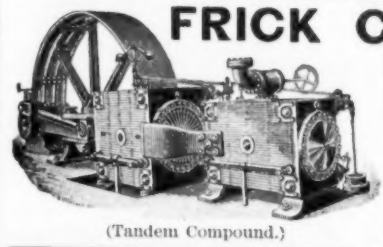

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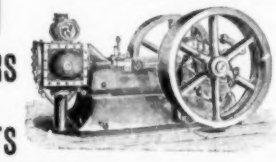

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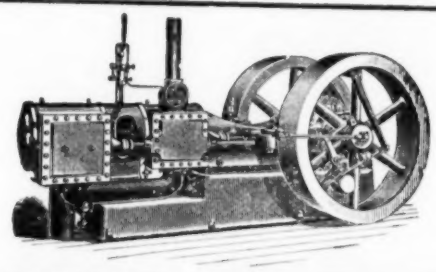

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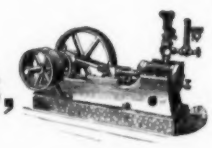

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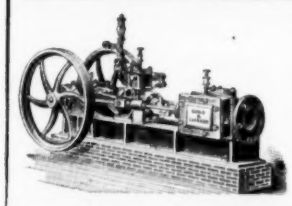

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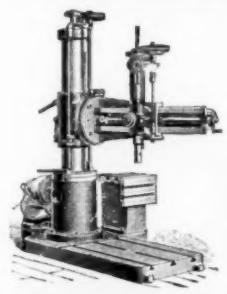

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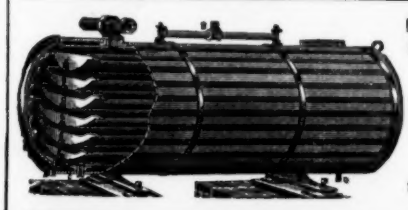

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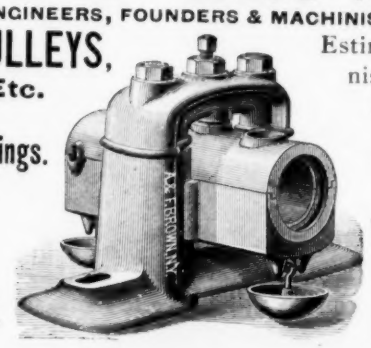

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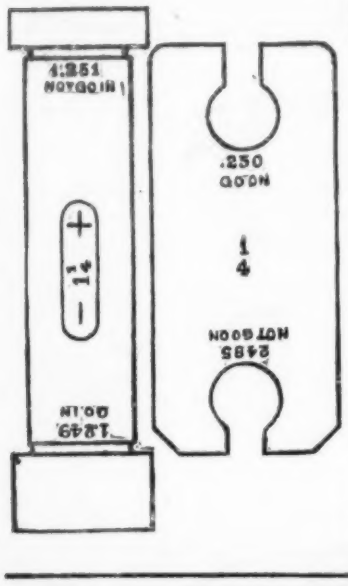

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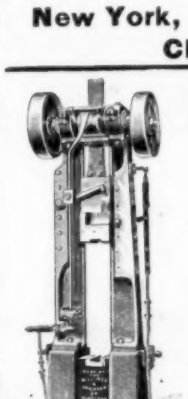

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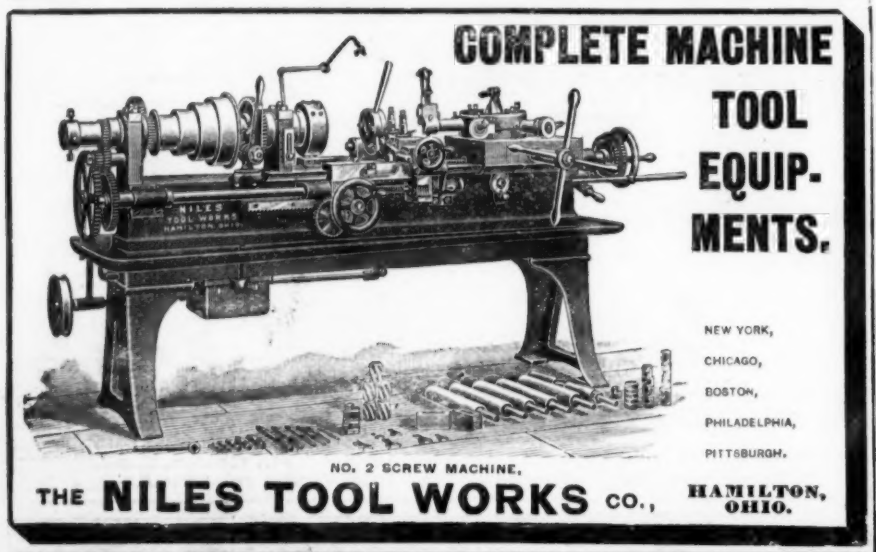

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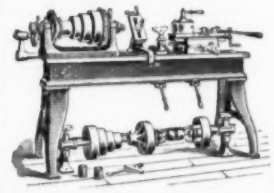

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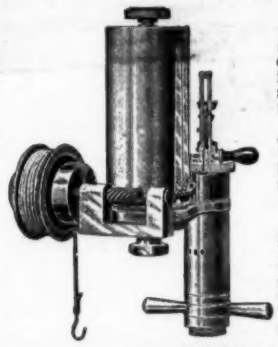

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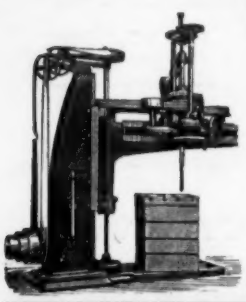

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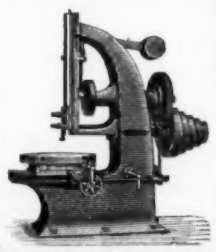

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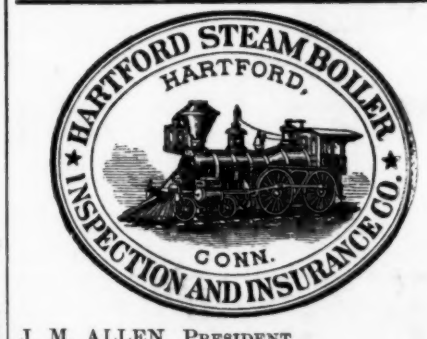

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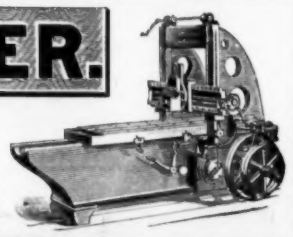

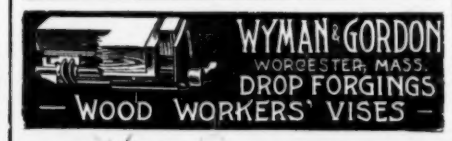

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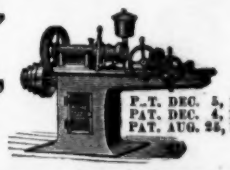

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